THE LOWER ORDOVICIAN STRATIGRAPHY AND TRILOBITES OF THE LANDEYRAN VALLEY AND THE NEIGHBOURING DISTRICT OF THE MONTAGNE NOIRE, SOUTH-WESTERN FRANCE

BY

WILLIAM THORNTON DEAN, Ph.D.

P. 245–353 ; 21 *Plates* ; 8 *Text-figures*

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
GEOLOGY Vol. 12 No. 6
LONDON : 1966

THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), *instituted in* 1949, *is issued in five series corresponding to the Departments of the Museum, and an Historical series.*

Parts will appear at irregular intervals as they become ready. Volumes will contain about three or four hundred pages, and will not necessarily be completed within one calendar year.

In 1965 *a separate supplementary series of longer papers was instituted, numbered serially for each Department.*

This paper is Vol. 12, *No.* 6 *of the Geological (Palaeontological) series. The abbreviated titles of periodicals cited follow those of the World List of Scientific Periodicals.*

TRUSTEES OF
THE BRITISH MUSEUM (NATURAL HISTORY)

Issued 20 *June,* 1966 *Price* £4 4s.

THE LOWER ORDOVICIAN STRATIGRAPHY AND TRILOBITES OF THE LANDEYRAN VALLEY AND THE NEIGHBOURING DISTRICT OF THE MONTAGNE NOIRE, SOUTH-WESTERN FRANCE

By W. T. DEAN

CONTENTS

CONTENTS—*contd.*

SYNOPSIS

The Ordovician rocks of the Montagne Noire around the Landeyran Valley are described and the following succession established, in ascending order : Schistes de Setso, Grès à Lingules, Couches du Foulon and Couches du Landeyran, the last-named being further subdivided into Couches inférieures and Couches supérieures. All these strata are assigned to the Extensus Zone of the Arenig Series. The Couches supérieures occur only in the southern half of the Landeyran Valley and are overstepped to north and south by unconformable Devonian beds. The trilobite faunas are discussed in detail and the following new species described : *Ceraurinella peregrinus, Ormathops borni, Prionocheilus matutinus, Colpocoryphe thorali, Neseuretus antetristani, N. arenosus, Platycoryphe convergens, Basiliella mediterranea, Hoekaspis? quadrata. Symphysurus sabulosus, Selenopeltis binodosus, Otarion insolitum* and *Apatokephalus incisus*. The relationships of the faunas with others in the Mediterranean Province and western China are discussed.

SOMMAIRE FRANÇAISE

Les roches ordoviciennes de la Montagne Noire dans la région de la vallée du Landeyran, au sud de St. Nazaire de Ladarez, sont décrites. La succession suivante est établie, en ordre ascendante : Schistes de Setso, Grès à Lingules, Couches du Foulon (après Le Foulon, une vieille maison au bord de l'Orb, au nord-est de Lugné), Couches du Landeyran inférieures et Couches du Landeyran supérieures. Toutes les couches appartiennent à l'Arenig inférieur, c'est à dire la zone de *Didymograptus extensus*. Les couches ordoviciennes sont pliées au-dessous des roches dévoniennes. Au bout nord de la vallée du Landeyran, et près du Foulon, les calcaires dolomitiques du Dévonien (le "Mur quartzeux" soi-disant) reposent avec grande discordance sur les schistes des Couches du Landeyran inférieures. Les Couches du Landeyran supérieures ne sont que trouvées sous le Devonien dans la moitié du sud de la vallée du Landeyran, mais leur faune est connue à Boutoury, près de Cabrières, 25 km. au nord-est. La faune des Couches du Landeyran inférieures paraît plus étendue au loin, et est connue pas seulement à Boutoury mais aussi, probablement, à l'Afrique du nord. Les relations des faunes avec les autres dans la région Mediterranée sont discutées. Les trilobites sont décrits en détail et renferment les nouvelles éspèces suivantes: *Ceraurinella peregrinus. Ormathops borni, Prionocheilus matutinus, Colpocoryphe thorali, Neseuretus antetristani, N. arenosus, Platycoryphe convergens, Basiliella mediterranea, Hoekaspis? quadrata, Symphysurus sabulosus, Selenopeltis binodosus, Otarion insolitum* et *Apatokephalus incisus.*

I. INTRODUCTION AND ACKNOWLEDGMENTS

THE south-westerly extension of the Massif Central into the départements of Hérault and Aude (part of the province of Languedoc) contains a number of mountainous districts, of which the best known to geologists is the Montagne Noire. This name is often used in a broad sense to include an area extending east-north-east from a point just north of Carcassonne towards Bédarieux and Clermont-l'Hérault. The region is separated from the Mediterranean by a coastal plain, some 30 kilometres wide, formed essentially of Mesozoic and Tertiary sediments. The Montagne Noire consists primarily of Pre-Cambrian and Palaeozoic rocks, the axial portion comprising a core of Pre-Cambrian rocks, around which are arranged successive layers of Palaeozoic strata, the whole having undergone extensive folding. Those of the southern slopes, in particular the Cambrian rocks, have long been the subject of classic research and we may, perhaps, single out the works of de Rouville and Bergeron in the last century, and of Miquel and Thoral during the present century. A long, detailed review of the considerable literature was published by Thoral (1935 : 475–483) in describing the geology of the country covered by the Bédarieux Sheet of the Service géologique de France.

In the vicinity of the town of St. Chinian, Ordovician rocks form a large curved outcrop, with maximum breadth just south of Roquebrun and narrowing to both north and south-west (see Text-fig. 1). The rock succession is in the main argillaceous, consisting of dark, concretionary mudstones and shales, together with some sandstones and, more rarely, limestones. The faunas of the sandstones are relatively sparse and poorly preserved but those of the mudstones and shales may be locally abundant, comprising especially trilobites and molluscs, with less common graptolites and brachiopods.

The Ruisseau de Landeyran (or Landayran, as it is shown on older maps) flows through a narrow gorge in Devonian and Carboniferous rocks from near the village of St. Nazaire de Ladarez, 22 kilometres north-north-west of Béziers, until it reaches a point one and a half kilometres south of the village. Near what is here termed the Upper Bridge (see Text-fig. 3) the river cuts through the lowest Devonian strata and enters a broader valley, the Landeyran Valley *sensu stricto* of geologists. This is excavated in relatively soft Ordovician mudstones and shales of the Arenig Series which are unconformably overlain by more resistant Devonian dolomitic limestones.

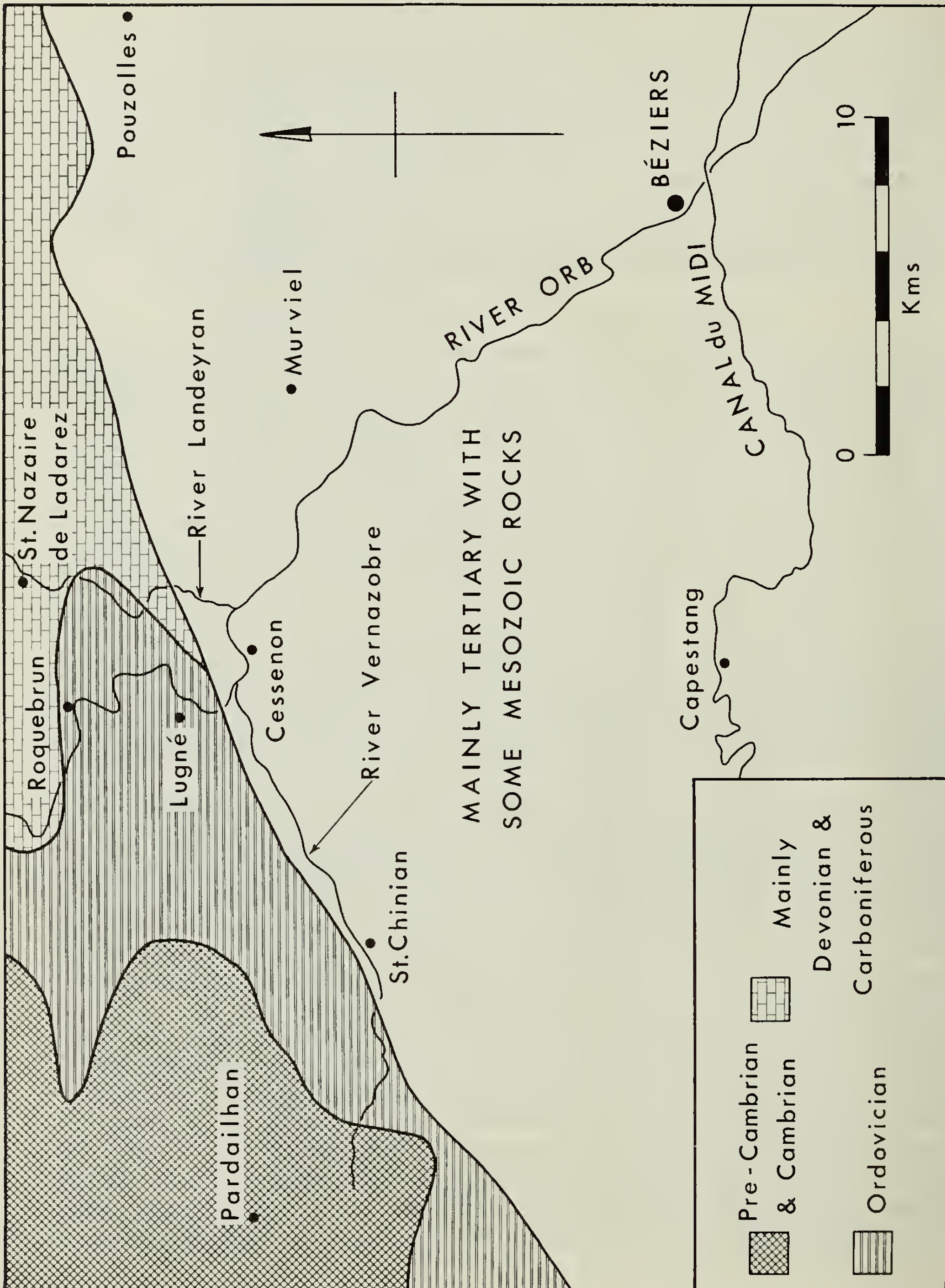


Fig. 1. Sketch-map showing part of the southern slopes of the Montagne Noire. The area described lies south-south-west of St. Nazaire de Ladarez.

The river follows an approximately south-south-westerly course for about two kilometres but then turns east-south-east at a point a few hundred metres upstream from Pont des Quatre Chemins, a bridge (see Text-fig. 3) marking the junction of the roads between St. Nazaire and Cessenon, and between Roquebrun and Causses-et-Veyran. Near the bridge the River Landeyran again intersects the Devonian outcrop and continues to join the River Orb, two and a half kilometres farther south. Apart from exposures in the bed of the river itself, the floor of the Landeyran Valley is mostly covered by Alluvium, extensively cultivated for the growing of vines. To the west of the valley the high, ridge-like feature of Serrelongue is composed of massive, yellow-weathering, often current-bedded sandstones, the Grès à Lingules, and these are underlain by conspicuously black, graptolitic shales, exposed in the Ruisseau de Setso (see Text-fig. 3) and referred to as the Schistes de Setso. The shales have yielded numerous specimens of *Didymograptus* as well as the trilobite *Taihungshania*.

Along the eastern side of Serrelongue runs the outcrop of the rocks succeeding the Grès à Lingules, a series of more flaggy sandstones and sandy shales discussed later under the name of Couches du Toulon. Most of the ground in this area is covered with thick maquis and examination of the strata is often difficult. The eastern margin of the Landeyran Valley is formed by massive, dolomitic limestones of Devonian age, the so-called " Mur Quartzeux " of French geologists. Owing to the large-scale and complex folding prevalent in this region, the strata here are vertical or even slightly overturned so that the Devonian beds, being more resistant than the adjacent Ordovician mudstones and shales, stand out as a parapet-like boundary, skirting the side of the valley and running east-north-east before curving westwards at both its northern and southern ends as mentioned earlier. The higher parts of the slopes formed by the Ordovician mudstones are generally covered with maquis whilst vineyards commonly occur on the lower slopes as well as over the alluvial flats.

The present paper deals mainly with the stratigraphy of the Ordovician rocks overlying the Grès à Lingules in the district between the River Orb near Le Foulon, north-east of Lugné, and the western margin of Mont Peyroux, south of St. Nazaire de Ladarez. In addition systematic descriptions are given of the numerous trilobites collected.

Detailed collecting was carried out by my wife and myself during the summers of 1961, 1962 and 1964, and I am indebted to the Trustees of the Godman Research Fund for financial assistance. Dr. Isles Strachan has identified all the graptolites found and commented on their geological horizons. Professor Avias and Monsieur M. Matte facilitated my examination of collections at the Geology Department of the University of Montpellier, whilst Professor M. Mattauer of the same university, who is engaged in remapping the geological structure of the region, supplied specimens and data collected by him and his students. Monsieur J. Destombes of the Service géologique du Maroc generously furnished information on the Ordovician rocks and faunas of the Anti-Atlas, as well as topotype specimens of *Calymene attenuata* Gigout. In Czechoslovakia Dr. R. Horný kindly allowed me to examine collections at the

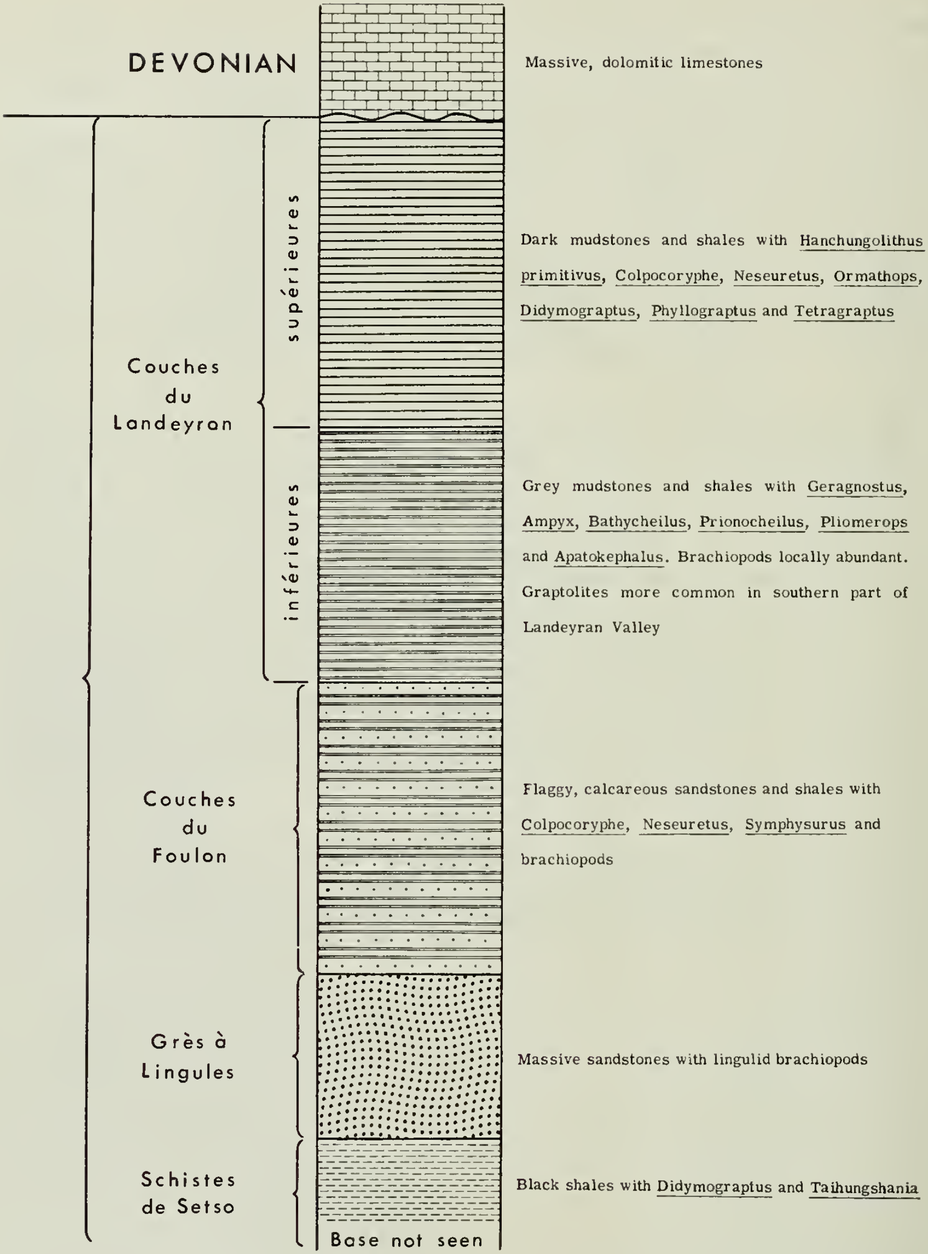


FIG. 2. Generalized succession of Ordovician rocks in the Landeyran Valley. Vertical Scale, 1 cm. = 40 m.

National Museum, Prague, and he, Dr. L. Marek and Mr. J. Vaněk supplied me with much useful information concerning Bohemian species. Finally, I am particularly grateful to the late Professor W. F. Whittard who, as on several previous occasions, kindly read and criticized the manuscript.

II. THE ORDOVICIAN SUCCESSION

Our detailed knowledge of the Ordovician stratigraphy of the Landeyran Valley arises from the researches of Thoral who first published a preliminary note (Thoral 1933) and soon afterwards put forward his ideas in more detail (Thoral 1935 : 490–494). He subdivided in descending order the strata succeeding the Grès à Lingules of the high ground of Serrelongue, from north-west to south-east, as follows.

4. Shales with *Phyllograptus angustifolius, Trinucleus primitivus, Dalmanites socialis, Dalmanites phillipsi, Dalmanella.*
3. Fossiliferous shales in vineyard on left bank of river, with *Calymene tristani, C.* cf. *aragoi, Trinucleus* cf. *primitivus, Didymograptus v-fractus, Phyllograptus angustifolius* and varieties.
2. Shales, sandy shales and nodules with *Didymograptus deflexus* and fragments of trilobites including *Homalonotus* (of Horizon 1) and *Symphysurus*, with *Redonia*, etc.
1. Grès à Lingules, overlain by black, sandy shales and siliceous nodules with micaceous sandstones. Fauna includes *Ogygia, Illaenus* and *Homalonotus* sp. nov.

Most of the extensive faunas collected by Thoral from the Tremadoc and early Arenig Series of the Montagne Noire were described by him in a large publication the same year (Thoral 1935*a*). The Arenig faunas had been obtained from the lowest part of that Series as interpreted by him, and their horizons fell within the so-called *Miquelina* (now *Taihungshania*) *miqueli* Zone, though one was from what are now termed the Schistes de Setso.

In a later paper Thoral (1941 : 140–141) gave the following succession for the Arenig Series in the region of the Orb Valley, particularly in the vicinity of the Landeyran Valley.

Schistes à *Phyllograptus* et à Trilobites (giving alternative names of Schistes de St-Nazaire or Schistes à Calymmene)
Schistes noirs de Setso
Grès à Lingules
Schistes psammitiques à *Didymograptus*
Schistes à *Miquelina miqueli* et *Vexillum*

In the same table Thoral used the terms " Schistes et grès à *Orthis* " and " Schistes du Foulon " for the strata succeeding the Grès à Lingules in the district of Le Foulon, but indicated some uncertainty as to their exact correlation.

The Cambrian and Ordovician agnostid trilobites of the Montagne Noire were described by Howell (1935) at about the same time that Thoral was describing the other shelly faunas, but the horizons, and sometimes localities, of some of the Ordovician forms were not known in great detail, and it was not apparent whether any of them were of stratigraphical value. Strangely enough, the faunas of the higher Arenig strata have remained largely undescribed. Similarly some of Howell's agnostids are now believed to be more restricted in their distribution than was once thought.

The most recent general account of the Lower Ordovician rocks in the Montagne Noire is that of Gèze (1949 : 42–46), though it does not deal with local details of stratigraphy. Gèze's map (1949, fig. 79) covering the neighbourhood of the Landeyran Valley indicated the strata above the Grès à Lingules as being subdivided into two parts. Generally speaking these were shown to occupy successively the western and eastern sides of the Landeyran Valley, forming a normal, undisturbed succession in the northern part of the valley and with their outcrops narrowing a little to the south-west, near Le Foulon. As will be explained later, such a hypothesis is not borne out by the present field observations. In his account of the Lower Ordovician stratal succession Gèze (1949 : 42) rightly stated that " Upper Arenig " and " Llandeilo " strata are absent from the district, but he adopted for the remainder of the Arenig Series a somewhat curious sequence in which certain of Thoral's (1941 : 140) local lithological subdivisions were elevated to the status of subzones within the *Didymograptus extensus* Zone, as follows :

Middle Arenig (=*Didymograptus extensus* Zone)	Subzone of *Didymograptus protobifidus* and *Phyllograptus angustifolius* Subzone of *Didymograptus deflexus* and *D. balticus* Subzone of *Didymograptus v-fractus*
Lower Arenig	Zone of Dichograptidae and Dendrograptidae Sandy shales with *Vexillum* and *Miquelina miqueli*

The definition of the Arenig Series and the graptolite zones constituting it have recently been reviewed by both Bulman (1958 : 164–165) and Whittard (1960 : 17–19). The zones into which this series is customarily divided derive primarily from the work of Elles (1904 ; 1922) and comprise, in ascending order, the two zones of *Didymograptus extensus* and *D. hirundo*. On the basis of her later work on the Skiddaw Slates of the English Lake District, Elles (1933 : 100–102) further subdivided the Arenig and higher Tremadoc Series as shown below. Bulman (1958 : 164) has pointed out that there is no evidence for the existence of a separate *Dichograptus* Zone, and has also cast doubt on the validity of the *Tetragraptus* Subzone, asserting that no concentration of *Tetragraptus* occurs at the base of the Arenig Series. He has, however, maintained the validity of the three topmost subzones of the Extensus Zone, but unfortunately it has not proved possible to apply these to the strata of the Landeyran Valley region, where the zone is not subdivided.

Series	Zone	Subzone
Arenig	*Didymograptus hirundo*	
	Didymograptus extensus	*Isograptus* [*Didymograptus*] *gibberulus* *Didymograptus nitidus* *Didymograptus deflexus* Upper subzone of *Tetragraptus* (reclined)
Tremadoc	*Dichograptus*	Lower subzone of *Tetragraptus* (horizontal)
	Bryograptus kjerulfi	

In the present paper the following succession is adopted for the Ordovician rocks below the unconformable Devonian in the vicinity of the Landeyran Valley.

- Couches du Landeyran
  - Couches supérieures
  - Couches inférieures
- Couches du Foulon
- Grès à Lingules
- Schistes de Setso

(*a*) *Schistes de Setso and Grès à Lingules*

The well-known occurrence of black, graptolitic shales in the stream-section of the Ruisseau de Setso, some 600 metres west of the River Landeyran, marks the lowest Ordovician horizon of the immediate district. Their total thickness, though not known with certainty, is probably small. At one time Thoral (1935 : 490) stated that the Schistes de Setso were the lateral equivalent of part of the Grès à Lingules. Later, however, he placed them stratigraphically higher than that horizon (Thoral 1941, table on pp. 140, 141). Such an interpretation is not supported by the various sections along the western side of the Landeyran Valley, and from his recent researches Professor Mattauer informs me (personal communication) that he regards the Schistes de Setso as being stratigraphically below the Grès à Lingules, a conclusion with which I agree. Fossiliferous shales form an outcrop in the Ruisseau de Setso about 1,250 metres north-north-west of Pont des Quatre Chemins. This section provided the various fossils noted by Thoral in his publications and was, in fact, marked by him as a fossil locality on the second edition of the 1 : 80 000 Bédarieux Sheet (Blayac *et al.* 1938). According to Thoral (1935*a* : 258) the Schistes de Setso, which yielded the type material of *Taihungshania miqueli* (Bergeron) *landayranensis* (Thoral), contain the graptolites *Didymograptus v-fractus* Salter and *D. v-fractus* var. *volucer* Nicholson. In Britain the two last-named occur in what Elles & Wood (1914 : 516) called the *Dichograptus* Zone and *Didymograptus extensus* Zone of the Arenig Series, and even though the *Dichograptus* Zone has been shown by Bulman (1958 : 164) to be non-existent, an early Arenig age is evidently indicated. My own collection from the Schistes de Setso contains numerous didymograptids identified as *Didymograptus* cf. *deflexus* Elles by Dr. Strachan who regards them as indicative of the Extensus Zone.

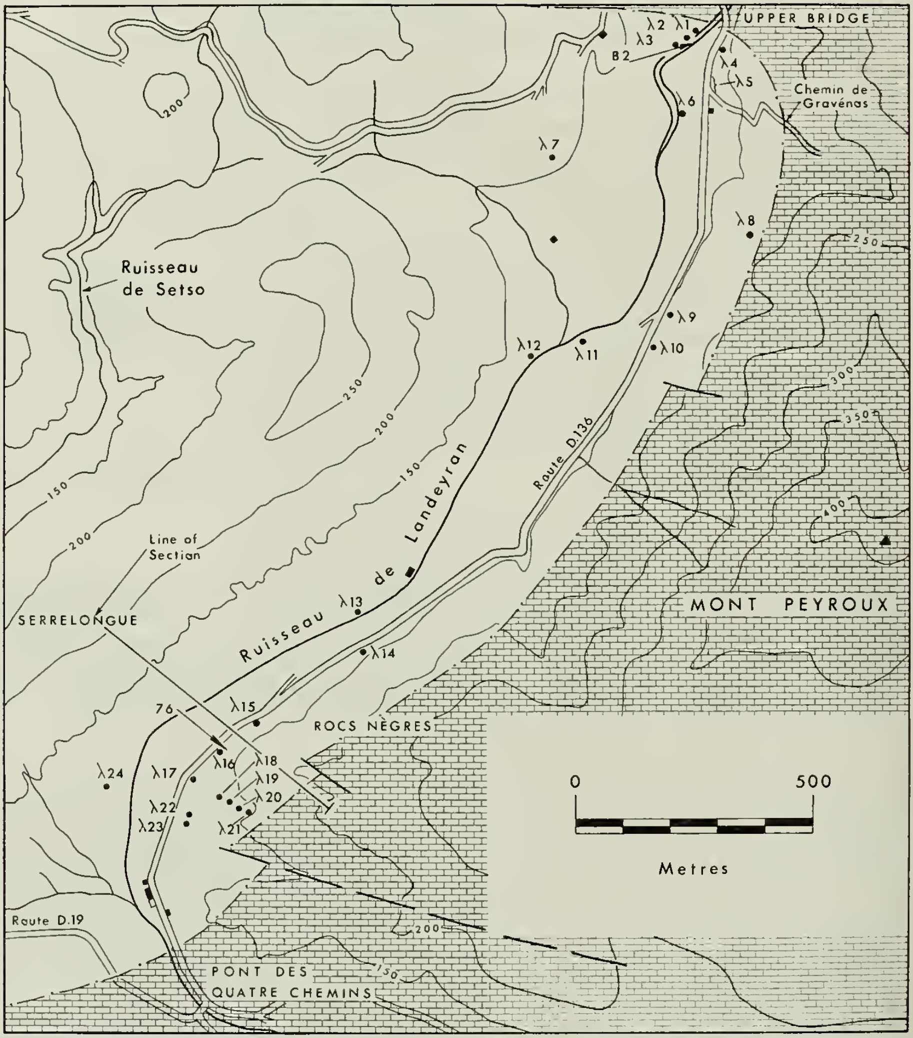


Fig. 3. Outline map showing principal fossil localities in the Landeyran Valley. Height of contours in metres. The l'Escougoussou district (see Text-fig. 5) lies beside Route D.19 immediately south-west of this map. Ordovician outcrop unshaded; brick-pattern denotes Devonian/Carboniferous rocks.

The Grès à Lingules comprise a series of massive, often impersistent sandstones and quartzites, frequently exhibiting shallow-water characteristics and having an estimated thickness of about 90 metres or more in the vicinity of Serrelongue. Apart from occasional occurrences of inarticulate brachiopods (*Lingula* s.l. and *Dinobolus*), most of the rocks are unfossiliferous and there is no evidence of their age with reference to the graptolite zones. Previous records of *Lingula crumena* Phillips from these strata are certainly mis-identifications, since the species occurs typically in the Lower Silurian (Llandovery Series) of England and Wales.

Thoral (1935 : 174) regarded the Grès à Lingules as being, without any doubt, equivalent to part of the " grès armoricains " of Brittany. It is tempting to equate such generally similar sandstone successions, but dangerous when dealing with shallow-water deposits, even over relatively short distances, not to mention the 700 or so kilometres between Brittany and the Montagne Noire. In practice there is no stratigraphical evidence to sustain Thoral's claim. The Grès à Lingules are known now to be of early Arenig age, whilst the Grès armoricain is overlain by the true Schistes à Calymènes, belonging to the *Didymograptus murchisoni* Zone, the upper graptolite zone of the Llanvirn Series (Dangeard 1951 : 46). It seems likely, therefore, that the Breton strata are no older than the lower part of the Llanvirn or the upper part of the Arenig Series.

(*b*) *Couches du Foulon*

The top of the Grès à Lingules is marked by the appearance of a series of flaggy and less massively-bedded sandstones, some of them with calcareous bands, and intercalated, grey, micaceous, sandy shales. The fauna is more varied than that from the underlying Grès à Lingules and the beds are grouped here to form a new stratal sub-division, the Couches du Foulon, which should not be confused with the old

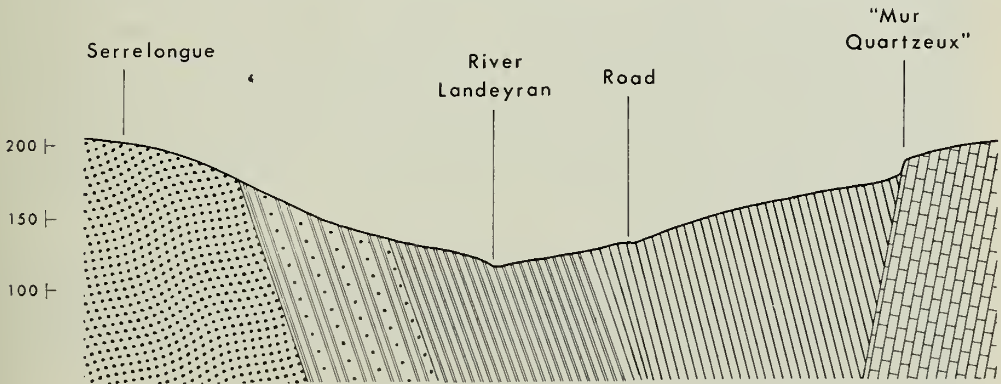


FIG. 4. Transverse (NW–SE) section showing the Ordovician succession in the southern part of the Landeyran Valley. Heights in metres. Scale, 1 cm = 50 m. For key to succession see Text-fig. 2.

name " Schistes du Foulon ". The latter was never adequately defined, though it was probably applicable to strata listed and described in the present account as the Couches du Landeyran inférieures, and its continued use seems inadvisable.

Thoral (1933 : 147), in discussing the Ordovician rocks of the Landeyran Valley, noted alternating sandstones and sandy shales with siliceous nodules overlying the Grès à Lingules. The same fauna was said to be found in the sandstones and the nodules, and to include " *Calymene* sp., *Asaphus* sp., *Orthoceras*, *Orthis*, *Redonia*, etc.". The beds were described by Thoral as being followed stratigraphically by blackish, sandy, micaceous shales, forming the southern flank of Serrelongue and containing the same fauna as before with the addition of crinoids and *Didymograptus*. The estimated maximum thickness of the Couches du Foulon is about 160 metres.

In geological papers dealing with the Montagne Noire frequent allusion is made to the district known as Le Foulon, but little detailed information and no large-scale geological map of the Ordovician succession have been published. Although the building marked as Le Foulon on the latest edition of the Saint Chinian Sheet of the Carte de France stands by the west bank of the River Orb, some 1,300 metres east of the village of Lugné, the district known by that name in much of the literature lies adjacent to the east bank of the river, about one and a half kilometres south-west of Pont des Quatre Chemins. A map published by Carles (1895) in an excursion guide to the district showed what were termed the " Terrasses du Foulon ", a name used for the so-called " meadows ", an area of marshy ground, by the east bank of the Orb where that river turns westwards towards Lugné. The name Le Foulon was applied originally to the now disused building and its associated system of aqueducts and outbuildings situated immediately by the east bank of the River Orb some 700 metres downstream from the Usine Maynard (see Text-fig. 5). This usage is retained for the present account.

The " Mur Quartzeux " of the unconformable Devonian rocks sweeps across the course of the River Landeyran near Pont des Quatre Chemins, skirts the lower hill slopes south of l'Escougoussou (fringing the high ground known as Puech Pus), and continues south-westwards until it stops just short of the River Orb, across the river from Lugné. A transverse section running roughly east-west through Lugné to near Siala by way of the Le Foulon district was published by Miquel (1895). This showed the Grès à Lingules followed successively by shales which were equated with the " Schistes de Boutoury ", the whole being overlain by the Devonian " Mur Quartzeux ".

The only detailed account of the Ordovician strata in the Le Foulon district is that of Thoral (1941 : 123). His findings are important, particularly with reference to the strata just above the Grès à Lingules (that is, the Couches du Foulon), and may usefully be summarized here. A traverse made in a north-south direction from the River Orb near Le Foulon along the bed of the stream flowing to the Orb from the Col de Siala produced the following succession, measured from the edge of the river's Alluvium. The dip of the beds was said to be south-south-east to east-south-east, and successively higher Ordovician strata were listed southwards to the unconformable Devonian " Mur Quartzeux ".

Devonian

Ordovician/Devonian junction masked by talus

Thick series of black shales with sandy bands situated at points 25 and 50 metres south of the Grès à Lingules outcrop. Beds dip at 55 degrees.	No thickness given
Slightly quartzose shales with hard calcareous nodules. Numerous fossils, but only undistorted in nodules. *Ogygia*, orthoceratids, *Orthis* (small), crinoids, etc.	1 to 2 metres
Alternating shaly and sandy beds	6 metres
Sandy black shales	1·5 metres
Dark sandstones, in thin beds	4 metres
Grès à Lingules in beds up to 1 metre thick with *Lingula lesueuri*. Shell bed of lingulids (3 cm. thick) near top of formation.	10 metres

The unconformable Devonian outcrop runs close to the River Orb near Le Foulon, just skirting the track leading from the Usine Maynard to Siala, but the Ordovician/Devonian junction is obscured by rock débris and vegetation. However, between the track and the river, particularly just downstream from Le Foulon, the alternating shales and sandstones of the Couches du Foulon are fairly well exposed. Still farther to the south-west the track to Siala forks, and near this point the highest Couches du Foulon are seen, dipping east at 40° and overlain by the Couches du Landeyran inférieures (for an account of these beds, see p. 265). The larger, south-easterly branch of the track continues up the hillside, at first almost following the strike of the sandstones and shales but then passing lower in the succession. West of the track at this point is the small, generally dry, valley which runs northwards to the River Orb from the high ground north-west of Siala, and in it the Couches du Foulon are well exposed. The outcrop of these strata continues south-westwards along the strike and occupies most of the hill formed by Ordovician rocks north-west of Vessas, where they are faulted against the Tertiary to the south-east (Gèze 1949, fig. 79).

In recent years Gigout (1956 : 2739–2740) has mentioned an unsorted collection made by Thoral from the "Middle Arenig" of the Landeyran Valley (the term Arenig being used by Thoral (1941 : 140) to comprise the lower Llanvirn Series in addition to the Arenig *s.s.*). Gigout noted the resemblance of the fauna to one he himself had described earlier (1951) from the region south-west of Casablanca, containing "*Calymene attenuata* Gigout, *Calymene* aff. *pulchra* Hawle & Corda and *Calymenella* aff. *media* (Barrande)." By kind permission of Professor Avias I have examined at Montpellier the Thoral collection cited by Gigout. Assembled in about 1932 the material, which is not yet sorted, is labelled as coming from the "Toit des Grès à Lingules" (that is, strata forming part of the present Couches du Foulon) at an unspecified locality said to be "near Pont de St. Nazaire", though this name appears to have been used indiscriminately in some older collections to denote either of the two bridges in the Landeyran Valley. The rock is a yellow-weathering, decalcified sandstone, part of which contains an abundant shelly fauna consisting in the main of brachiopods and trilobites. The latter mostly comprise disarticulated asaphids with *Neseuretus* and *Symphysurus*. The exact position of Thoral's locality has not yet been rediscovered, and outcrops of this horizon in the southern part of the Landeyran Valley are singularly unproductive, though the area is large and collecting often difficult. However, near the northern end of the valley, at locality $\lambda 7$, massive and flaggy sandstones with some calcareous bands and shales were examined, the whole being well-jointed and the shales slickensided. The more calcareous bands yielded poorly-preserved *Colpocoryphe*, *Neseuretus* and a few brachiopods. No other fossil localities have yet been found in these strata within the limits of the map shown in Text-fig. 3.

(*c*) *Couches du Landeyran*

Although bands of sandy, micaceous shale are found intercalated with the flaggy sandstones of the Couches du Foulon, they have not proved fossiliferous in the present instance and are often slickensided. The following account of the Couches du Landeyran deals, therefore, only with the succeeding, more or less continuous, sequence of dark mudstones and shales. These contain occasional siliceous nodules and concretionary bands sometimes exhibiting " cone-in-cone " structure. The rocks are mostly dark grey or grey-green in colour, though the shales of the Couches inférieures are generally a paler grey. Graptolites are sometimes preserved in relief, especially in light grey shales low in the succession, but are often pyritic films in the darker beds. " Shelly " fossils occur mostly in the darker strata, occasionally with part of the calcareous shell preserved but generally in the form of ochreous internal and external moulds with the intervening space filled by an amorphous mass of orange, limonitic material. Although fossils were generally found scattered throughout the succession, in some cases they were collected from thin bands which showed signs of sorting.

The shelly faunas are of a composition broadly similar to that of many other Lower and Middle Ordovician successions of dark mudstones and shales, for example those of Bohemia, the Iberian Peninsula, north-western France, and the Anglo-Welsh area (see pp. 345–348). They consist mainly of trilobites, the dominant groups present being trinucleids, dalmanitids and asaphids, with subsidiary, though important, agnostids, calymenids (*s.l.*) and raphiophorids. Molluscs are generally abundant, particularly bivalves such as *Redonia*, as are supposed phyllopods (*Ribeiria*) and hyolithids, but brachiopods are usually uncommon, apart from a few localized occurrences with numerous shells occurring in bands.

The section near Le Foulon (see p. 258) was claimed by Thoral (1941 : 124) as the only one that could be followed bed by bed upwards from the Grès à Lingules. The so-called fossiliferous " Schistes du Foulon " were said to be absent there, though they were described as cropping out a little farther east, at the margin of the cliff formed by the Devonian " Mur Quartzeux ", between it and the road which, coming from Le Foulon, "connects the meadows situated downstream ". Thoral said that the relationships of the " Schistes du Foulon " were thus difficult to distinguish. They followed above the black shales of the section taken at the eastern side of the outcrop described above, and should be found under the scree or were covered by the transgressive Devonian rocks. The succession is discussed later in this chapter. According to Thoral, on following the Ordovician/Devonian junction the " Schistes du Foulon " appeared either to pass laterally into the " Schistes à *Phyllograptus* " (now Couches du Landeyran supérieures) of Le Touraillas (a locality in the Landeyran Valley ; see p. 258) or to rest upon them. Thoral noted, however, that isoclinal folds could exist within the Ordovician shales and suggested that the " Schistes du Foulon " should be placed at least 100 metres, and probably 200 metres, above the Grès à Lingules.

Graptolites were said to be both rare and of little variety, all being of the tuning-fork type and belonging to the *protobifidus/bifidus* group of *Didymograptus*. On account of the similar graptolites in the " *Phyllograptus* Beds " of Le Touraillas, and the supposed affinity between the trilobite faunas of the " Schistes du Landeyran " and the " Schistes du Foulon " Thoral concluded that both formations were of approximately the same age, and that both were slightly higher than the *Didymograptus deflexus* Subzone. His results were summarized in a table (Thoral 1941 : 140–141) as follows :

		Middle Valley of the Orb	
		Le Foulon	Le Landeyran
Didymograptus extensus Zone	Subzone of *D. gibberulus*	?	Shales with *Phyllograptus* and trilobites
	,, ,, *D. nitidus*	Schistes du Foulon	
	,, ,, *D. deflexus*	Shales and sandstones with *Orthis*	
		— — — —	Black shales of Setso
	,, ,, *Tetragraptus* (reclined)	Grès à Lingules	
		?	

Elsewhere, in a paper devoted mainly to the Silurian and topmost Ordovician rocks of Languedoc, Thoral (1941*a*, table) listed the following succession for the Ordovician strata of the middle valley of the River Orb :

Schistes du Foulon à *Didymograptus protobifidus*
Schistes de St. Nazaire à *Phyllograptus*
Schistes de St. Nazaire à *Didymograptus defluxus* [sic]
Grès à Lingules
Grès et schistes à nodules de l'Arénig inférieur et du Trémadoc.

No reasons were given for this assignment of the beds at Le Foulon to an horizon stratigraphically higher than the strata of the Landeyran Valley, and such a sequence can no longer be sustained.

(*i*) *Couches du Landeyran inférieures*

The Landeyran Valley

At the northern end of the Landeyran Valley, almost 200 metres downstream from the Upper Bridge, there is a right-angled bend in the course of the river (see Text-fig. 3). At this point almost vertical, or even slightly overturned, massive and flaggy sandstones of the Couches du Foulon are well exposed in the western bank of the river. They are succeeded downstream by Couches du Landeyran inférieures, sometimes with brachiopods (for example at λ6), whilst immediately upstream they appear to be separated by a small fault from further outcrops of the Couches inférieures which can then be followed successively upwards towards the Upper Bridge. Apart from occasional outcrops most of the eastern bank of the river is occupied by Alluvium, but the higher western bank and the river bed exhibit a fairly continuous succession, which is taken as the type-section of the Couches inférieures. The section is best examined in late spring and summer when the flow of river water is almost non-existent. The rocks mostly comprise strongly jointed and often highly compacted mudstones, and the clockwise rotation of the strike observed as followed southwestwards from the Upper Bridge is attributable to subsidiary folding of the less competent Ordovician strata within the large overfold of the Devonian " Mur Quartzeux ". The Couches inférieures in the northern part of the valley vary in colour from light or dark grey to purple and contain sporadic concretionary bands which sometimes exhibit cone-in-cone structure. The lower strata of the section south-west of Upper Bridge did not prove particularly, or diagnostically, fossiliferous but a fossil-band at λ3 yielded fragments of large asaphid trilobites in a dark grey micaceous mudstone. Farther towards the bridge, however, the strata become more fossiliferous and faunas were collected at λ1 and λ2, particularly the latter. At λ2, in the north-western bank of the river, fossils were found fairly commonly through about one metre of rock, and a thin (15 cm.) horizon yielded an interesting assemblage of trilobites and brachiopods. The former include *Geragnostus*, *Apatokephalus*, *Bathycheilus*, *Colpocoryphe*, *Pliomerops*, *Prionocheilus* and asaphid fragments. Brachiopods at λ2 include a few lingulids and more common dalmanelloids, the latter being found in still greater abundance some 20 metres upstream, in grey shales exposed in the north-western bank at λ1. No other significant fossiliferous horizons were found between λ1 and the Devonian unconformity near the Upper Bridge, but a fauna broadly similar to that of λ2 was examined by the roadside at λ5. At this point, by the eastern side of the road some 24 metres south of its intersection with the Devonian unconformity, several bellerophontid gastropods, including *Sinuites*, were found in association with *Apatokephalus*, *Colpocoryphe* and asaphid fragments, some of large size. Another locality (λ6), in the south-eastern bank of the river yielded several brachiopods and its horizon may not be far removed from that of λ1. The strike of the beds brings these northernmost Couches inférieures to the track-section in the western part of the Chemin de Gravénas and beneath the adjacent vineyards, where fragments of fossiliferous mudstone are often turned up by the plough.

Additional and numerous exposures of the Couches inférieures were examined in the area about 450 metres south of the Upper Bridge, both near the roadside and on the hill-slopes to the east, where the beds are overlain by the Couches supérieures at and near $\lambda 8$ (see p. 269). Fossils may be locally abundant but are badly preserved and consist mainly of gastropods and bivalves. Similar strata occur still farther south near localities $\lambda 9$ and $\lambda 10$ as well as to the south-west, both in the river bed (localities $\lambda 11$ and $\lambda 12$) and in the stream which joins the River Landeyran from the north-west (see Text-fig. 3). In and near the stream section are large exposures of the Couches inférieures, here almost unfossiliferous and strongly jointed, which may be traced north-westwards as far as their junction with the underlying Couches du Foulon, some 250 metres north-west of the stream/river intersection.

The mudstones and shales of the Couches inférieures along and to the west of the western bank of the River Landeyran still farther south proved to be almost barren, yielding only poorly-preserved bivalves, gastropods and fragmentary asaphids. The lowest beds are poorly exposed, being covered by thick maquis, but the thickness of the Couches inférieures in this area has been estimated at about 140 metres. The outcrop around locality $\lambda 24$ (see Text-fig. 3) is dissected by some small, dry stream-courses which facilitated the collecting of the few available fossils. These included the almost ubiquitous gastropods and bivalves together with a few brachiopods, an assemblage generally similar to those found at the northern end of the valley.

The l'Escougoussou district

About 600 metres west-north-west of Pont des Quatre Chemins lies the farm known as l'Escougoussou, by the north side of the road (Route D.14) leading from Murviel, *via* the bridge, to Roquebrun. The road from the Landeyran Valley to the Orb Valley attains its highest point here and passes through a large " notch " eroded in the shales and mudstones cropping out between the more resistant masses formed by the Grès à Lingules of Serrelongue (to the north) and the Devonian " Mur Quartzeux " of Puech Pus (to the south). The main farm-building borders the northern side of the road, and opposite its western end is a large exposure of what are apparently Couches du Foulon, in the steep, southern side of the road. The rocks, which comprise massive and flaggy sandstones with subsidiary shales, dip steeply south-eastwards and have not yet yielded recognizable fossils. They are followed stratigraphically by part of the Couches du Landeyran inférieures, here a series of shales and mudstones, pale, greenish-grey in colour and with a steep, variable dip to the south-east. The beds are often slickensided and weathered, tending to crumble easily, so that fossil-collecting is difficult. Exposures occur along both sides of the road, particularly the southern side, for a distance of more than a hundred metres, and fossils may be found throughout most of the visible succession. Their state of preservation is not generally good, however, but the localities which proved most profitable are shown in Text-fig. 5. The fauna is essentially graptolitic. Pendent didymograptids are the most common forms, with an occasional tetragraptid. Non-graptolitic fossils are uncommon but include occasional trilobites (asaphid fragments and *Colpocoryphe?* sp. indet.), a few brachiopods (including lingulids and

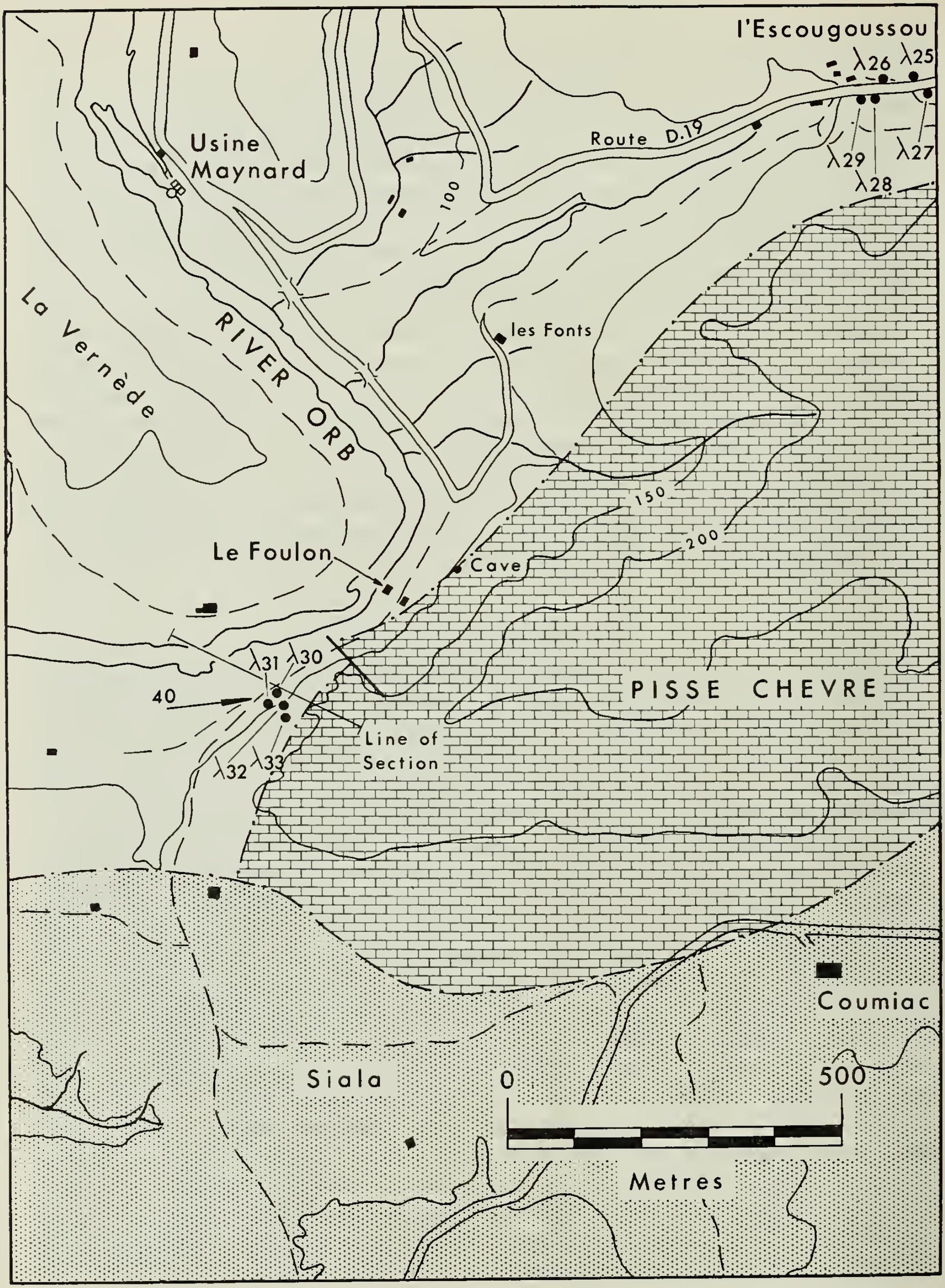


FIG. 5. Sketch-map showing fossiliferous localities in the Couches du Landeyran inférieures near l'Escougoussou and south-west of Le Foulon. The shaded area around Siala represents the Tertiary outcrop; the Devonian/Carboniferous rocks are denoted by the brick-pattern; the Ordovician outcrop is unshaded.

dalmanelloids), with *Ribeiria*, *Redonia* and some poorly-preserved gastropods. The graptolites have been examined by Dr. I Strachan whose determinations are shown below. He considers the shaly succession here to belong to the *Didymograptus extensus* Zone.

	Graptolite Localities				
	λ25	λ26	λ27	λ28	λ29
Didymograptus sp.	×	×	×	—	—
Didymograptus? sp.	—	—	—	—	×
Tetragraptus pendens Elles?	—	—	—	×	—
Tetragraptus? sp.	—	—	×	—	×

It is interesting to note a certain lack of correspondence between the mudstones of the Couches inférieures at the northern and southern ends of the Landeyran Valley. The mainly graptolitic strata of l'Escougoussou do not, as far as we know, have counterparts near the Upper Bridge. Conversely, the trilobitic strata of λ2 and its vicinity have not yet been found near l'Escougoussou. However, the relationships may be obscured by both structural complications as well as by the Alluvium.

The district near Le Foulon

The Usine Maynard (or Moulin Maynard as it is shown on certain maps) is situated by the eastern bank of the River Orb some two kilometres north-east of the village of Lugné and about one kilometre west-south-west of the farm l'Escougoussou. About 700 metres south-south-east of the Usine Maynard is the section through what are now the Couches du Foulon which was described by Thoral (1941 : 123). Above these strata are found outcrops of the present Couches du Landeyran inférieures, that is to say mudstones and shales to which the name " Schistes du Foulon " has previously, and loosely, been applied. No detailed map or faunal list has been published for the district, a curious omission in view of the allegedly fossiliferous strata there and the attempts made to correlate them with other beds. Thoral (1941 : 125) claimed that there was a strong analogy between the trilobitic faunas of what he called the " Schistes du Landeyran " and the " Schistes du Foulon ". He concluded that both horizons were of approximately the same age, higher than the *Didymograptus deflexus* Subzone, and represented the upper part of the " Middle Arenig ". Referring to his " Horizon 4 " in the Landeyran Valley (now equal to at least part of the Couches du Landeyran supérieures) Thoral (1935 : 493) stated that between the " *Phyllograptus* horizon " and the Devonian there occurred grey-green shales in which no determinable fossils were found. He concluded that these might " represent the Upper Arenig and Llandeilo as at Le Foulon ", though there was no palaeontological proof. His hypothesis introduced complications of large lateral variations of faunal facies which do not appear to exist, and must now be abandoned.

The Couches du Landeyran inférieures are best exposed in the Le Foulon district in the steep hillside between the Devonian " Mur Quartzeux " and the track from the Usine Maynard to Siala, at a point about 250 metres south-west of the true Le Foulon and above the fork in the track some 750 metres south-south-east of the

Usine Maynard. The rocks comprise dark, grey-green mudstones and shales, deeply weathered so that the section is obscured by a scree of fine shale fragments. In consequence the fossils, which tend to be found concentrated into thin bands, are not always easy to find. They may, however, be locally abundant and it is reasonable to suppose that the old collections labelled merely " Le Foulon " originated here. Most of the section was sampled and four principal fossiliferous horizons were found. Additional fossil-bands probably exist but they are difficult to find owing partly to the degrees of weathering and partly to their own impersistent nature. The succession of the Couches du Landeyran inférieures in this section is summarized below (Text-fig. 7). There is room here for a total thickness of approximately 50 metres, and the horizons of the principal fossil localities are shown, but the thickness farther south may be greater. The fauna is more abundant than at the corresponding level in the Landeyran Valley, and a particularly interesting feature is the distribution of *Bathycheilus gallicus*, here ranging through most of the succession whereas it has been found at only one locality near the Upper Bridge.

Although the poor exposures make it difficult to demonstrate the fact, the outcrop of the Couches du Landeyran inférieures widens slightly to the south-west of the hillside section just described and narrows north-eastwards near Le Foulon. Still farther north-east the ground is again poorly exposed and the beds are not seen clearly again until the vicinity of l'Escougoussou is reached.

The section of the Couches du Landeyran inférieures near Le Foulon is of particular interest in two respects. First, it illustrates once again the folding of the Arenig strata beneath the Devonian unconformity, so that the Couches du Landeyran supérieures have been eliminated by overstep at Le Foulon, as they have at the northern end of the Landeyran Valley. Secondly, it shows the striking resemblance between the shelly faunas of the Couches inférieures at Le Foulon and in the north

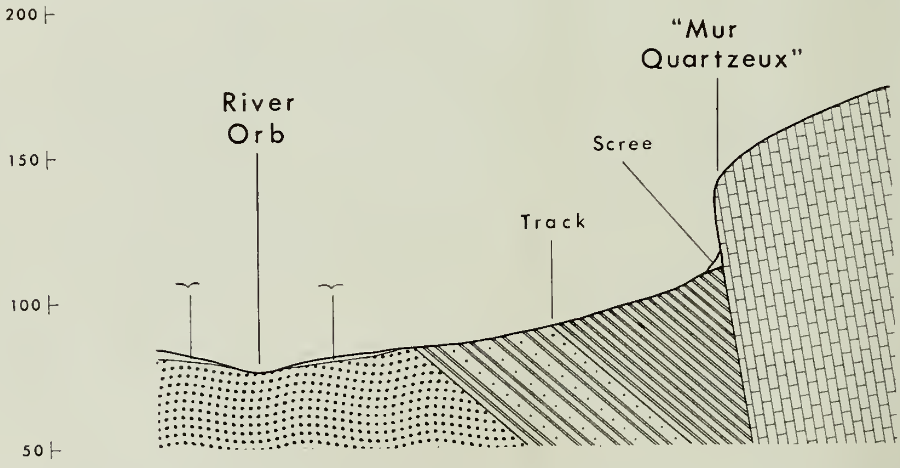


Fig. 6. Transverse (WNW–ESE) section showing the relationship of the Ordovician and Devonian rocks south-west of Le Foulon. For key, see Text-fig. 2. Scale, 1 cm. = 25 m.

of the Landeyran Valley, even though the equivalent faunas of the intervening l'Escougoussou area are very different. I have not yet examined in detail the Ordovician outcrops of the Boutoury district, near Cabrières, but the old collections at Montpellier University contain numerous trilobites from there. Several of the characteristic forms of the Couches inférieures (and also the Couches supérieures) are represented and their matrix does not differ significantly from that of the Landeyran–Le Foulon district. The distribution of trilobites, as known at present, is shown in tabular form below. In order to convey some idea of the relative abundance of the different genera and species, the following, purely arbitrary convention is used. Very common = 10 or more specimens ; Common = 7–9 specimens ; Uncommon = 4–6 specimens ; Rare = 1–3 specimens ; a dash indicates that the genus has not yet been found. For the column dealing with the Boutoury district, a cross merely shows that the genus is known in museum collections.

	Northern end of Landeyran Valley	Le Foulon	Boutoury
Ampyx . . .	Rare	Uncommon	×
Apatokephalus . .	Uncommon	Very common	×
asaphids . . .	Very common	Very common	×
Bathycheilus . .	Common	Very common	×
Ceraurinella . .	—	Rare	—
Colpocoryphe . .	Common	Very common	×
Geragnostus . .	Uncommon	Very common	×
Ormathops. . .	—	Rare	—
Pliomerops . .	Rare	—	×
Prionocheilus . .	Common	—	—
Selenopeltis . .	—	Rare	—

(*ii*) *Couches du Landeyran supérieures*

The highest members of the mudstone succession in the Landeyran Valley are generally better defined, in terms of faunal content, than the Couches inférieures. These topmost strata, which he termed " Horizon 4 ", were discussed briefly by Thoral (1935 : 492–493). " Horizon 4 " constitutes all, or at least part of, what are now called the Couches du Landeyran supérieures. Thoral followed Born (1921) in regarding the shelly faunas of these beds as being " stratigraphiquement neutres " and therefore of little use compared with the graptolites, as they were thought to include species ranging from the Arenig to the Llandeilo Series. Born's original faunal list, however, is now known to contain numerous misidentifications, and Thoral's pessimism can no longer be shared. Perhaps the most conspicuous feature is the incoming of trinucleid trilobites, a group which otherwise is poorly represented in the Ordovician rocks of the Montagne Noire. All the specimens so far found belong to the genus *Hanchungolithus* Lu 1954, and to the species *Hanchungolithus* [*Trinucleus*] *primitivus* (Born), recently redescribed by Whittard (1957) as *Myttonia* *primitiva*. The Couches du Landeyran supérieures form a considerable outcrop along the south-eastern side of the Landeyran Valley, particularly in the type-section about 400 metres north of Pont des Quatre Chemins, and have an estimated thickness of approximately 170 metres. The lateral extension of these strata elsewhere in the Montagne Noire is indicated by the presence, in older collections at Montpellier University, of several specimens of *Hanchungolithus primitivus* from Boutoury, about 25 kilometres to the north-east.

In his various publications dealing with the district around the Landeyran Valley, Thoral frequently alluded to a locality known as " Le Touraillas " or " Le Toaraillas " (for example, Thoral 1941 : 122). No such place is shown on the map of the area but from Thoral's account, and his mention of " la falaise schisteuse du Touraillas ", it appears that he was probably referring to the section to the south-west of Rocs Nègres, some 600 metres north-north-east of Pont des Quatre Chemins. This is the type-section of the Couches du Landeyran supérieures, which are well exposed there.

By the eastern side of the St. Nazaire road about 440 metres north of Pont des Quatre Chemins is a large exposure (see Text-fig. 3, locality $\lambda 17$) where mudstones and shales have been quarried. This is the type-locality of *Trinucleus primitivus*. It was cited by Spjeldnaes (*in* Whittard 1957) who, on the basis of graptolites found there, suggested that the horizon probably formed part of the Llanvirn Series, though Whittard (*loc. cit.*) noted that *Myttonia*, the genus to which he then assigned *Trinucleus primitivus*, was known only from the Arenig Series in West Shropshire.

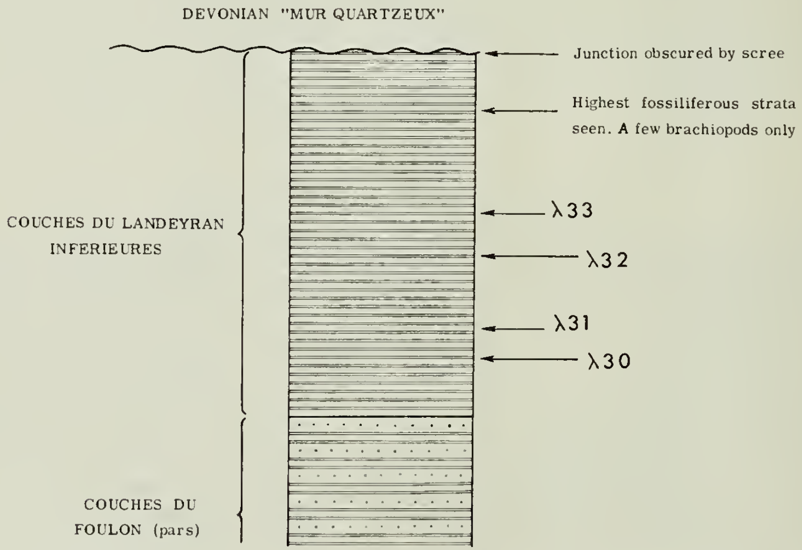


Fig. 7. Succession of the highest Ordovician strata the Devonian unconformity south-west of Le Foulon, showing the stratigraphical position of the principal fossil localities. Vertical Scale, 1 cm. = 10 m.

A large, new collection of graptolites was obtained from this and nearby localities. Individuals are common but the number of species is small, and amongst them Dr. I. Strachan has identified the following : *Didymograptus* cf. *deflexus* Elles & Wood, *D.* cf. *nanus* Lapworth, *Phyllograptus* cf. *angustifolius* Hall, *Tetragraptus* cf. *reclinatus* Elles & Wood. Dr. Strachan (personal communication) considers that all these graptolites are suggestive of what Monsen (1936) called the *Phyllograptus densus* Zone, that is to say, part of the *Didymograptus extensus* Zone of the Arenig Series, according to the more usual convention of Ordovician zoning, though he warns against too detailed correlation over such a large distance and prefers to use here only the Extensus Zone (undivided). The associated shelly fauna contains mainly trilobites and bivalves, but brachiopods, phyllopods and machaeridians also occur (see faunal list).

The Couches supérieures are exposed for some distance along the road in the direction of St. Nazaire de Ladarez. The rocks are generally strongly cleaved and precise measurements are difficult to make, but a south-easterly dip of 76° was obtained at one point. South-east of the St. Nazaire road at locality λ16, the same strata form a wide outcrop which extends up the hillside towards the Devonian " Mur Quartzeux ". Many fossils were collected from a south-easterly traverse made here and the principal localities are shown in Text-fig. 3. The fauna is fairly uniform throughout, with only relatively small variations. *Hanchungolithus primitivus* ranges through the complete succession, having been collected only a few metres below the " Mur Quartzeux ", the actual Ordovician/Devonian junction being obscured by scree. Although lacking at a few points, *Colpocoryphe thorali* extends into the highest Couches du Landeyran, but *Ormathops borni* is known only from the lowest portion (perhaps 85 metres) of the Couches supérieures.

The most fossiliferous outcrops found are those in the south of the Landeyran Valley, where the strata are less disturbed tectonically, but the presence of uncommon specimens of *Hanchungolithus primitivus* enables the Couches supérieures to be traced along the south-eastern side of the valley. The most northerly fossiliferous exposures were found at and near λ8 (see Text-fig. 3). Thence the outcrop narrows north-eastwards below the Devonian unconformity and is judged to terminate along the hill slope to the south-east of the track known as Chemin des Gravénas (see Text-fig. 3). As already stated, the vineyards in the area north of the track are underlain by the Couches du Landeyran inférieures.

The southern extension of the Couches supérieures is limited, and the rocks are absent from the sections near Le Foulon. Accurate mapping is difficult owing to lack of exposures, but a single poorly-preserved specimen of *Hanchungolithus primitivus* found loose on the hillside south-east of l'Escougoussou suggests that the outcrop ends nearby, as the Couches inférieures exposed in the road-section by the farm strike south-westwards towards the adjacent base of the Devonian rocks, only some 150 metres distant. The specimen is preserved in a more compacted, splintery matrix than is found in the sections north of Pont des Quatre Chemins.

The folding of the Couches du Landeyran below the unconformable Devonian is shown in Text-fig. 8 by means of vertical sections. Outside the Landeyran district the Couches inférieures and Couches supérieures are known from the Boutoury area, near Cabrières, whilst species common to the St. Chinian district and the neighbourhood of the Landeyran Valley and Le Foulon suggest a westwards extension of at least the lower subdivision. However, some facies change might be expected near St. Chinian as the earlier Grès à Lingules do not occur there, nor have any species of the Couches du Landeyran supérieures been found.

The second edition of the 1 : 80 000 Bédarieux Sheet of the Carte géologique de la France (see Blayac *et al.* 1938) gives an over-simplified picture of the Ordovician stratigraphy of the Landeyran Valley–Le Foulon district. It shows the Grès à Lingules of Serrelongue as being followed by two successive groups of strata. The lower of these is indicated as forming the whole of the outcrop between the River Orb and the Devonian " Mur Quartzeux " to the south-west of Le Foulon. The same strata reappear to the north-east, occupy the area between l'Escougoussou and Pont des Quatre Chemins, and then form a nearly parallel-sided outcrop along the western bank of the River Landeyran as far as the Upper Bridge. The outcrop of the higher series of strata is indicated as beginning near Pont des Quatre Chemins and continuing north-eastwards without structural complications, terminating at the Devonian outcrop by the Upper Bridge. The higher strata may be regarded as approximately equivalent to the Couches du Landeyran supérieures and their outcrop should, in fact, extend slightly farther south-westwards towards l'Escougoussou, and terminate in a north-easterly direction before reaching the Upper Bridge. The lower series approximates to the Couches du Foulon plus the Couches du Landeyran inférieures, the structural relationships of which are far from simple at the northern end of the Landeyran Valley.

To summarize, the entire Ordovician succession in the vicinity of the Landeyran Valley may be assigned to the *Didymograptus extensus* Zone of the Arenig Series. The lowest strata, the graptolitic Schistes de Setso, constitute a restricted development and may be represented elsewhere by Thoral's *Taihungshania* [*Miquelina*] *miqueli* Zone. Likewise, the Grès à Lingules probably pass into mudstones to the west and are unknown farther east. Of the Couches du Landeyran, the Couches inférieures contain a distinctive fauna found also at Boutoury and probably also in North Africa, whilst the Couches supérieures are found in a syncline preserved beneath the unconformable Devonian strata of the Landeyran Valley. Their fauna, characterized by *Hanchungolithus primitivus*, occurs also at Boutoury but is unknown elsewhere.

III. FAUNAL LISTS

All the species collected are listed alphabetically within Classes, and in numbered columns denoting stratigraphical subdivisions as follows: 1, Schistes de Setso; 2, Grès à Lingules; 3, Couches du Foulon; 4, Couches du Landeyran inférieures; 5, Couches du Landeyran supérieures. Several brachiopods were found but are excluded from the present lists as they are to form the subject of a separate study by Prof. A. Williams.

FIG. 8. Diagram
ne

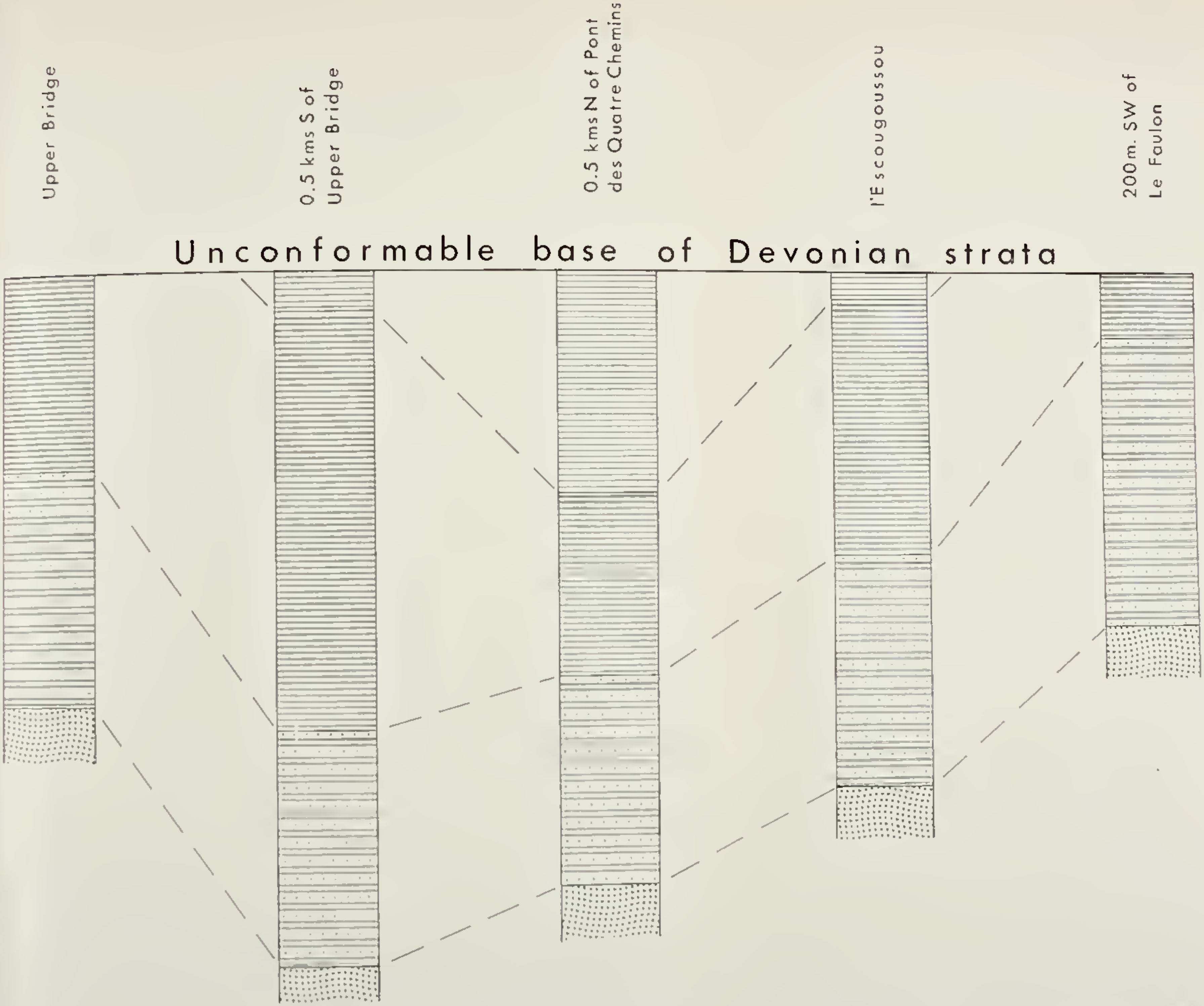


FIG. 8. Diagram illustrating the correlation of the higher Arenig rocks at various points between the northern end of the Landeyran Valley and the Orb Valley near Lugné. The base of the Devonian provides a convenient datum line. For key, see Text-fig. 2. Vertical Scale, 1 cm. = 40 m.

	1	2	3	4	5
Hyolithida					
Hyolithes (s.l.) sp.	—	—	—	×	×
Graptolithina					
Didymograptus deflexus Elles & Wood	—	—	—	—	×
D. cf. *deflexus* Elles & Wood	×	—	—	—	×
D. cf. *minutus* Törnquist	—	—	—	×	—
D. cf. *nanus* Lapworth	—	—	—	×	—
D. cf. *protobifidus* Elles	—	—	—	×	—
D. cf. *protoindentus* Monsen	—	—	—	×	—
Didymograptus sp.	—	—	—	×	×
Phyllograptus angustifolius Hall	—	—	—	—	×
Phyllograptus sp.	—	—	—	—	×
Tetragraptus cf. *pendens* Elles?	—	—	—	×	—
T. cf. *reclinatus* Elles & Wood	—	—	—	×	—
T. cf. *serra* (Brongniart)	—	—	—	—	×
Asterozoa					
Chinianaster levyi Thoral	—	—	—	×	—
Machaeridia					
Lepidocoleus sp.	—	—	—	—	×
Plumulites sp.	—	—	—	—	×
Conularida					
Eoconularia? cf. *azaisi* (Thoral)	—	—	—	×	—
Bivalvia					
Babinka prima Barrande?	—	—	—	—	×
Redonia cf. *prisca* Thoral	—	—	—	×	×
cf. *Synek antiquus* Barrande	—	—	—	×	×
Gastropoda					
"*Bellerophon*" cf. *oehlerti* Bergeron	—	—	—	×	×
Lesueurilla cf. *prima* (Barrande)	—	—	—	×	—
Sinuites sp.	—	—	—	—	×
Cephalopoda					
Orthoconic nautiloids indet.	—	—	—	—	×
Phyllopoda?					
Anatifopsis cf. *trapeziiformis* Thoral	—	—	—	—	×
Ribeirella crassa Thoral	—	—	—	—	×
Ribeiria personata Thoral	—	—	—	×	×
R. personata obsoleta Thoral	—	—	—	×	—
Ostracoda					
Primitiid ostracods indet.	—	—	—	×	×

Trilobita	1	2	3	4	5
Ampyx priscus Thoral	—	—	—	×	—
Apatokephalus incisus sp. nov.	—	—	—	×	—
Asaphids indet.	×	—	×	×	×
Basiliella mediterranea sp. nov.	—	—	—	×	×
Basiliella sp.	—	—	—	—	×
Bathycheilus gallicus Dean	—	—	—	×	—
Ceraurinella peregrinus sp. nov.	—	—	—	×	—
Colpocoryphe thorali sp. nov.	—	—	—	×	×
Colpocoryphe sp.	—	—	×	—	—
Geragnostus mediterraneus Howell	—	—	—	×	—
G. occitanus Howell	—	—	—	×	—
Hanchungolithus primitivus (Born)	—	—	—	—	×
Hoekaspis? quadrata sp. nov.	—	—	—	×	—
Megalaspidella (*Megalaspidella*) sp.	—	—	—	×	×
Megistaspis (s.l.) sp.	—	—	—	—	?
Megistaspis (*Ekeraspis*) sp.	—	—	—	×	×
Neseuretus antetristani sp. nov.	—	—	—	—	×
N. arenosus sp. nov.	—	—	×	—	—
N. cf. *arenosus* sp. nov.	—	—	—	×	×
Niobella fourneti (Thoral)	—	—	—	×	—
N. cf. *lignieresi* (Bergeron)	—	—	—	×	—
Niobella? sp.	—	—	—	×	—
Ormathops borni sp. nov.	—	—	—	×	×
Otarion insolitum sp. nov.	—	—	—	—	×
Paramegalaspis cf. *frequens* Thoral	—	—	—	×	×
Paramegalaspis sp.	—	—	×	×	×
Platycoryphe convergens sp. nov.	—	—	—	—	×
Pliomerops escoti (Bergeron)	—	—	—	×	—
Prionocheilus matutinus sp. nov.	—	—	—	×	—
Proetid gen. et sp. indet.	—	—	—	×	—
Selenopeltis binodosus sp. nov.	—	—	—	×	—
Symphysurus sabulosus sp. nov.	—	—	×	—	—
Taihungshania landayranensis (Thoral)	×	—	—	—	—
Taihungshania sp.	—	—	—	—	×

IV. SYSTEMATIC DESCRIPTIONS OF THE TRILOBITES

Family **AGNOSTIDAE** M'Coy 1849

Although Thoral had available a small number of specimens of agnostid trilobites from the Montagne Noire, most of them collected earlier by Miquel, he did not describe them and the material formed the subject of a paper by Howell (1935). In this publication specimens of Middle Cambrian, Tremadoc and Arenig age were described, but only the Arenig forms, or at least a majority of them, are reviewed here. They were assigned by Howell (1935 : 231–238) to four genera, *Trinodus*, *Geragnostus*, *Leiagnostus* and *Micragnostus*. The last three names were new, founded on species from countries other than France, and although it is not proposed here to revise these genera, nevertheless the species from the Montagne Noire assigned to them by Howell are all now placed in *Geragnostus*.

The agnostids from the so-called " Schistes à Calymènes " of Le Foulon and Boutoury were kept apart from those of the Arenig Series at Barroubio and near St. Chinian by Howell, who followed Thoral in assuming that two distinct geological horizons were involved. The present researches suggest that most of, if not all, the Arenig agnostids of this region originate from a single series of strata, those now termed the Couches du Landeyran inférieures, or their lateral equivalents. There is only a single record of agnostids (Thoral 1933 : 148) from what are now called the Couches du Landeyran supérieures. This was not subsequently repeated and I have been unable to confirm it, nor are any agnostids to be found in the appropriate collections at Montpellier University. Howell's descriptions were generally brief and his illustrations suggest an undue amount of " splitting " into species. The original material has been examined in conjunction with my new collections, and as a result I consider that all Howell's species of *Geragnostus*, together with *Leiagnostus foulonensis* Howell and *Micragnostus languedocensis* Howell, may be grouped into no more than two, somewhat variable species of *Geragnostus*.

Genus ***GERAGNOSTUS*** Howell 1935

1939. *Geragnostella* Kobayashi : 167.

In recent years Whittard (1955 : 7) has maintained *Geragnostella* as a separate genus on the basis of the subtriangular cephalon and glabella, the form of the pygidium, and details of the axial region. The genus was founded by Kobayashi (1939 : 167) as a subgenus of *Geragnostus*, using as type-species *Agnostus tullbergi* Novák (1883 : 59, pl. 9, figs. 7–10), described first from the Šárka Beds (Llanvirn Series) of Osek, near Rokycany, Bohemia. A cast of specimens from the same horizon at Šárka, near Prague, figured in manuscript by Novák, is figured here for comparison (Pl. 2, figs. 4, 9). It shows that the tip of the pygidial axis is circumscribed, even though only faintly, by the posterior continuation of the axial furrows, and thus cannot be said to differ significantly from the axis in *Geragnostus*. There is also a very small median tubercle, the same as that called a terminal node by Palmer (1955, text-fig. 1), near the axial tip in *Agnostus tullbergi*, but this is not considered to be of great systematic significance. The cephalon of *Agnostus tullbergi* is indistinguishable from that of a typical *Geragnostus*, and in view of the variability now known to occur within the latter genus I prefer to regard *Geragnostella* as a junior subjective synonym of *Geragnostus*.

In discussing the agnostids from the Montagne Noire, Howell (1935 : 231, 233) erected two separate families, Geragnostidae and Trinodidae, but later recognized their equivalence (*in* Moore 1959 : O 176). The difficulties of distinguishing between *Geragnostus* and *Trinodus* have been discussed by both Ross (1958 : 563–564) and Whittington (1963 : 28). The type-species of *Trinodus*, *T. agnostiformis* M'Coy (1846, pl. 4, fig. 3) from the Ordovician (undifferentiated) of Greenville, Co. Wexford, Eire, was redescribed by Whittington (1950 : 533, pl. 68, figs. 1–3). Unfortunately the thorax and pygidium of *T. agnostiformis* are still not known, and it is therefore impossible to define the genus satisfactorily until they have been described. Nevertheless, various species in which the cephalon generally resembles that of *T. agnostiformis* have been assigned to *Trinodus*, for example *T. tardus* (Barrande) figured by Whittington (1950, pl. 68, figs. 4–6), although such identifications must necessarily assume certain facts which are not yet known. The species attributed to *Trinodus* have in common a relatively short pygidial axis which narrows backwards to a rounded tip, is defined by a continuous furrow, and carries a pair of small anterolateral lobes together with a median tubercle followed immediately by a transverse furrow. Further research may show these features to be insufficient to maintain *Trinodus* and *Geragnostus* as separate genera, in which case *Trinodus* would take precedence.

Girvanagnostus was erected by Kobayashi (1939 : 166, 167, 174, plate) who listed it variously as a subgenus of both *Trinodus* and *Geragnostus*. Howell (*in* Moore 1959 : O 177) has given *Girvanagnostus* full generic status even though Whittard (1955 : 7) had earlier cast doubt on its validity. The Gray Collection at the British Museum (Natural History) contains numerous specimens of the type species, first described as *Agnostus girvanensis* Reed (1903 : 4, pl. 1, figs. 2–4) ; they include the original of Reed's pl. 1, fig. 2, which is here chosen as lectotype, specimen number In. 20609. The radial furrows shown in Reed's reconstruction of the cephalon and pygidium are imaginary, founded only on accidents of preservation, and the species is otherwise indistinguishable from *Trinodus*.

Geragnostus occitanus Howell

(Pl. 1, figs. 1–12 ; Pl. 2, figs. 1–3, 7)

1935. *Geragnostus occitanus* Howell: 231, pl. 23, figs. 4, 5.
1935. *Leiagnostus foulonensis* Howell : 236, pl. 23, figs. 17, 18.
1935. *Geragnostus languidus* Howell : 237, pl. 23, figs. 19–21.
1935 .*Geragnostus boutouryensis* Howell : 237, pl. 23, figs. 22, 23.

Localities and horizon. In the Landeyran Valley–Le Foulon district *Geragnostus occitanus* has been found only in the Couches du Landeyran inférieures, as, in fact, have all other agnostids collected. Localities λ2 and λ5, both near the northern end of the Landeyran Valley, have yielded mainly this species, which has also been found to range through virtually all the succession exposed in the hillside section 250 metres south-west of Le Foulon. Locality λ32 proved particularly rich, and an interesting feature of the strata near Le Foulon is the large proportion of entire dorsal exoskeletons preserved, indicating relatively quiet conditions of deposition.

Figured material. Brit. Mus. (Nat. Hist.) In. 57417 (Pl. 2, fig. 7) ; In. 57418 (Pl. 2, fig. 1) ; In. 57419 (Pl. 2, figs. 2, 3) ; It. 140 (Pl. 1, fig. 1) ; It. 141 (Pl. 1, fig. 2) ; It. 142 (Pl. 1, fig. 3) ; It. 143 (Pl. 1, fig. 4) ; It. 144 (Pl. 1, figs. 5, 9) ; It. 145 (Pl. 1, fig. 6) ; It. 146 (Pl. 1, figs. 7, 12) ; It. 147 (Pl. 1, figs. 8, 11) ; It. 148 (Pl. 1, fig. 10).

Description. The entire dorsal exoskeleton is approximately, or slightly more than, half as broad as long, though all the specimens examined have been affected to at least a slight degree by dorsal compression. The cephalon is basically subquadrate in plan, the median length being slightly less than the maximum breadth, measured across the mid-point. The frontal and lateral margins of the cephalon are broadly rounded, uniting at anterolateral angles which are also rounded, though with a smaller radius of curvature. The glabellar outline is elongated, semi-elliptical in plan, the basal breadth about two-thirds of the median length. It is circumscribed by a continuous furrow, representing the conjoined axial and preglabellar furrows, which varies in its degree of definition. Sometimes it becomes almost obsolete, particularly frontally, and is generally slightly broader and deeper on internal moulds. At its posterolateral extremities the glabellar outline extends opposite the mid-points of a pair of occipital lobes, each an obtuse triangle in plan with apex directed forwards. These lobes would have been called " basal glabellar lobes " using the terminology of Palmer (1955, fig. 1), but Whittington (1963 : 28) suggests that they are more suitably termed occipital lobes, and his convention is followed here. The occipital lobes are separated by a small, node-like structure which is generally obscured by crushing ; it corresponds to the "median band of the occipital ring " illustrated by Whittington (1963). Immediately outside each occipital lobe is a short (*tr.*), narrow (*exsag.*) posterior border, defined by a furrow which is generally well developed but may be shallow. The border is transversely straight as far as the fulcrum where it expands suddenly to form a short, bluntly-pointed, fixigenal spine (see especially Pl. 1, fig. 9). The glabella carries a small median tubercle at a point slightly in front of centre and immediately behind the apex of a chevron-shaped furrow which is faintly impressed and broadly divergent forwards. Both the furrow and the median tubercle may become almost obsolete, and some specimens show a slight indentation of the lateral margins of the glabella opposite the median tubercle.

The thorax consists of two dissimilar segments of almost equal size, and the descriptive terminology used here is that of Whittington (1963 : 29, fig. 3). The first segment is subrectangular in plan, the length (*sag.*) about a quarter of the breadth (*tr.*), this, in turn, being slightly less than the distance between the lateral border furrows of the cephalon. Most of the segment is occupied by the axial ring, the pleurae being reduced to narrow (*tr.*) strips, their abaxial margins indented at the outer ends of pleural furrows which divide the pleurae into two bands, both of them slightly swollen and the anterior band noticeably the larger. The anterior third of the axial ring is flattened and set lower than the remaining two-thirds, which is divided into three lobes by deep, broad furrows. The median lobe is slightly larger than the lateral lobes and trapezoidal in plan, the sides converging forwards strongly from a posterior margin which occupies about one-third of the breadth (*tr.*) of the segment. The lateral lobes are lozenge-shaped with their long axes converging forwards. The second thoracic segment is shorter (*sag.*) and broader (*tr.*) than the first segment, with an axial ring of similar size and form preceded by a well-developed articulating half-ring. The pleural lobes curve forwards and end in blunt points beyond the pleural tips of the first segment. On each pleura a pleural furrow curves forwards to the tip and separates a narrow (*exsag.*) anterior band from a posterior band approximately twice as broad.

The pygidium is slightly smaller than the cephalon, the median length more than three-quarters of the maximum breadth, and moderately convex both longitudinally and transversely. The axis occupies about half the frontal projected breadth of the pygidium and more than two-thirds its projected length in, presumably, adult specimens. The sides of the axis converge backwards at about 40° over the anterior two-fifths of their length, but then become less convergent towards the rounded axial tip. Owing to diminution of the furrow defining it, the tip of the axis is sometimes almost indiscernible. The break in continuity of the sides of the axis coincides with a transverse furrow which is sometimes moderately impressed but is more often almost obsolete. Between this furrow and the front of the pygidium the median quarter of the axis is occupied by a raised, longitudinal rectangular structure, the hindmost part of which expands dorsally to form a median tubercle. The frontal two-fifths of the " rectangular structure " are a little broader and coincide with a pair of anterolateral lobes which are delimited posteriorly by a transverse furrow which, like the one behind it, may be moderately impressed or almost obsolete. The pleural lobes are gently convex, decline laterally at about 45° though less so posteriorly, and each has a projected breadth about half that of the axis. The anterior end of each pleural lobe is marked by a narrow (*exsag.*) anterior border, the hindmost part of which is ridge-like, standing higher than the pleural lobe and lateral border, and meeting the latter at an obtuse angle. A deep, narrow (*exsag.*) furrow, continuous with the lateral border furrow, separates the anterior border from the rest of the pleural lobe. The foremost part of the anterior border is declined steeply forwards to form a large articulating facet, running outwards and slightly back. The function of similar facets during enrollment has been demonstrated for *Geragnostus clusus* by Whittington (1963, fig. 3) and is also found in *G. tullbergi* (Novák) (see Pl. 2, fig. 10). The pygidial border broadens a little posterolaterally, where one may find traces of a pair of small, backwardly-directed marginal spines sited approximately in-line with the axial tip.

An interesting feature emerging from the present sample of *Geragnostus occitanus* is the large amount of variation encountered. North American specimens of the same genus were shown by Whittington (1963 : 30) to have the axial furrows of both cephalon and pygidium deeper and broader on internal moulds, owing to folding of the normal thickness of the test, and similar features have been found in the French specimens. In addition, the degree to which the axial furrows, transverse glabellar furrow, median tubercles and pygidial ring furrows are developed, even on the external mould, varies considerably, and one may find gradations between forms in which furrows and tubercles are well defined, and others in which the corresponding features are almost obsolete. This variation does not appear to be dependent on the stage of development attained, and supposedly immature individuals may show obsolete furrows like those of adults. The smallest specimens are, however, characterized by broader cephalic and pygidial borders, as well as by a rather more rectangular pygidial outline.

Discussion. This will be found on p. 278, after the description of *Geragnostus mediterraneus*.

Geragnostus mediterraneus Howell

(Pl. 2, figs. 5, 6, 8)

1935. *Geragnostus callavei* (Raw) var. *mediterraneus* Howell : 231, pl. 23, figs. 6, 7.
1935. *Geragnostus pusio* Howell : 232, pl. 23, fig. 8.
1935. *Micragnostus languedocensis* Howell : 233, pl. 23, fig. 10.
1935. *Geragnostus manifestus* Howell : 238, pl. 23, figs. 24, 25.

Figured specimen. Brit. Mus. (Nat. Hist.) In.57420 (Pl. 2, figs. 5, 6, 8).

Locality and horizon. The only undoubted example of *Geragnostus mediterraneus* found during the present field-work was obtained from the Couches du Landeyran inférieures at locality λ2, in the north-western bank of the river near the northern end of the Landeyran Valley.

Description. For all practical purposes the cephalon of *G. mediterraneus* may be regarded as being indistinguishable from that of *Geragnostus occitanus*, and the single pygidium of *G. mediterraneus* from the Landeyran Valley was found in association with several cephala and pygidia, all of which could be assigned to *G. occitanus*, as interpreted from the type material of that species. The same may also be said of the thorax.

The pygidial outline is transversely straight frontally, and well rounded posteriorly, the frontal breadth about five-sixths of the median length (excluding the articulating half-ring). It is circumscribed by a raised border of variable breadth which is separated from the remainder of the pygidium by a shallow, concentric border furrow. The margin is produced posterolaterally to form a pair of short, backwardly-directed spines, the bases of which are sited opposite the tip of the pygidial axis. The latter is large, occupying frontally almost half the maximum pygidial breadth, with a length almost three-quarters that of the pygidium. It is moderately convex both longitudinally and transversely, and the dorsal surface is almost level over the anterior two-thirds of its length, after which it declines to the axial tip. The outline of the axis narrows a little medially, opposite the second segment, giving a waist-like appearance. The axial tip is broadly rounded in plan, dorsally convex, and the whole axis is delimited by a continuous, uniformly deep furrow. The anterolateral corners of the axis show the development of a pair of small lobes, transversely elongated and subtriangular in plan. Each lobe occupies just over one-third of the frontal breadth of the axis and between one-fifth and one-sixth of its median length. Immediately behind this pair of lobes the axis is crossed by a transverse segment of length slightly greater than that of the anterolateral lobes, delimited by a shallow, transverse furrow and carrying a well-developed, slightly elongated (*sag.*), median tubercle. The tubercle is best developed in the second segment of the axis, behind which it is abruptly truncated, but frontally it dies away more gradually, opposite the anterolateral lobes.

Discussion. In addition to the holotype of *Leiagnostus foulonensis* Howell, a species now placed in the synonymy of *Geragnostus occitanus*, there are, in the collections of the University of Montpellier, two paratypes which deserve mention. One of these, in the Blayac Collection and numbered H.63, is not a trilobite but comprises two small, conjoined valves of the bivalve *Redonia*, bearing a superficial resemblance to the cephalon and pygidium of an agnostid trilobite. The sample numbered H.64 in the Guiraud Collection contains three specimens labelled *a.* (two specimens) and *b.* Of these *b.* is a paratype of *Geragnostus boutouryensis* Howell (now *Geragnostus occitanus*) whilst *a.* is said to be a paratype of *Leiagnostus foulonensis*. One of the two specimens labelled *a.* is too poorly preserved to be certain of its trilobite affinities, whilst the other contains no trilobites, but exhibits the poorly-preserved remains of several small bivalves, possible immature *Redonia*. Two of the valves lie in juxtaposition and, again, simulate an agnostid trilobite, as in the case of paratype H.63. The holotype of *Micragnostus languedocensis* Howell, also in the University of Montpellier, is a very small pygidium, so abraded that it can scarcely be considered identifiable. Judging from the form of the axis, however, it seems probably that the species is founded on an immature specimen of *Geragnostus mediterraneus*. The same may be said for the aptly-named *Geragnostus pusio*, erected on a single, immature pygidium.

Geragnostus mediterraneus was erected by Howell as a variety of *G. callavei* (Raw), but is regarded here as a separate species. *G. callavei* was first described, as *Agnostus callavei* (Raw *in* Lake 1906 : 25, pl. 2, fig. 20), from the Shineton Shales (Tremadoc Series) of Shropshire and may be distinguished by its narrower, less tumid, more parallel-sided pygidial axis in which the posterior segment is slightly longer and notably less expanded than that of *G. mediterraneus*. In addition, the glabella of the Shineton species is parallel-sided over most of its length and relatively broad frontally, contrasting with the almost subtriangular glabella of *G. mediterraneus*.

Kobayashi (1937 : 463) drew attention to what he claimed as a gradual reduction in the surface relief of the exoskeleton in *Geragnostus occitanus*, *G. boutouryensis* and *G. languidus*. Although not specifically stated, his text implies that he believed these to be successive morphological changes, and he had probably been misled by the allegedly later horizon of the two latter species. He also noted " remarkable flanges " (presumably broad pygidial borders) on the pygidia of *G. boutouryensis* and *G. languidus*, features which are present on smaller individuals and are exaggerated by dorsal compression.

The cephalon of *Geragnostus hirundo* Hicks sp. (1875 : 176 ; see also Whittard, 1955 : 7) from the, probably, upper Arenig Series of the Shelve Inlier and South Wales bears an overall similarity to those of *G. occitanus* and *G. mediterraneus* but has a better defined glabella with a deep, transverse furrow and no median tubercle. The pygidial axis resembles that of *G. mediterraneus* in having an expanded posterior segment but is relatively shorter whilst the pygidial border is broader. *Geragnostus caducus* Barrande sp. (1872 : 142 ; see also Whittard 1955 : 8) from the Llanvirn Series of the Shelve Inlier and Bohemia has a cephalon which, according to Whittard, is distinguishable from that of *G. mediterraneus* only by its having a second glabellar furrow. The pygidium of *G. caducus* has not been described from the type area but Whittard (1955 : 9) has noted a Shropshire specimen as showing some resemblances to that of *G. hirundo*.

Geragnostus fritschi Holub (1908 : 9, pl. 2, fig. 1), from the Šárka Beds (Llanvirn Series) of Osek, Bohemia, has a well-defined pygidial axis rather like that of *G. mediterraneus*, though with a less expanded posterior segment, whilst its glabella is less tapered than that of the French species and has two deep, transverse furrows. Another species from the Šárka Beds, *G. tullbergi* (Novák) has already been discussed and some of the more obvious differences noted.

Several species of *Geragnostus* have been described or redescribed from the Lower Ordovician of Sweden by Tjernvik (1956). *Geragnostus sidenbladhi* (Linnarsson), the type species of the genus, from the late Tremadoc Series, has a pygidial axis and glabella which are much more parallel-sided than those of any species in the Montagne Noire (Tjernvik 1956 : 188). *G. wimani* Tjernvik (1956 : 192) from the early Arenig Series closely resembles *G. occitanus* in several respects and the cephala are almost identical, but the anterior half of the pygidial axis of the Swedish species is more strongly convergent, followed by a slightly smaller posterior segment than that of the French form. The apparently broader pygidial border of *G. wimani* may be due to compression. *G. crassus* Tjernvik (1956 : 190), from the later Tremadoc and early Arenig Series, has a cephalon generally similar to that of *G. occitanus* and *G. mediterraneus*, though with a broader border. The pygidium of *G. crassus* is very like that of the latter species in having a large posterior axial segment, but the axis is slightly broader and more parallel-sided than that of *G. mediterraneus*.

Family **RAPHIOPHORIDAE** Angelin 1854

Genus *AMPYX* Dalman 1827

Ampyx priscus Thoral

(Pl. 3, figs. 1–9 ; Pl. 4, figs. 1–6)

1935*a*. *Ampyx priscus* Thoral : 305, pl. 28, figs. 7–10, pl. 30, fig. 6.
1946. *Ampyx priscus* Thoral ; Thoral : 92.

LECTOTYPE, here chosen. The cranidium figured by Thoral 1935*a*, pl. 28, fig. 9. A cast of this specimen is now illustrated (Pl. 3, figs. 3, 4, 9).

FIGURED MATERIAL. Brit. Mus. (Nat. Hist.) I.15880 (Pl. 3, fig. 6) ; It.150 (Pl. 3, figs. 1, 7 ; Pl. 4, fig. 1) ; It.151 (Pl. 4, fig. 2) ; It.152 (Pl. 4, fig. 3) ; It.153 (Pl. 4, fig. 4) ; It.154 (Pl. 4, fig. 5) ; It.155 (Pl. 4, fig. 6) ; also specimens in the University of Montpellier, including Pl. 3, fig. 5, and a cast (Pl. 3, figs. 2, 8) of a paralectotype pygidium figured by Thoral (1935*a*, pl. 28, fig. 10).

LOCALITIES AND HORIZONS. All the specimens of *Ampyx priscus* collected from the Landeyran Valley–Le Foulon district during the present field-work were obtained from the Couches du Landeyran inférieures. Most were collected from $\lambda 32$ at the hillside section 240 metres south-west of Le Foulon, but the species occurred also at

λ30, 31 and 33. A single specimen (Pl. 3, fig. 6) from an unspecified locality in the Landeyran Valley, collected some years ago by C. Escot and now in the British Museum (Natural History), is probably also from the same horizon, judging by the state of preservation. Several others occur in old collections from the Boutoury district (for example, Pl. 3, fig. 5), probably at the same horizon. The type material came from the St. Chinian district, some 14 kilometres south-west of the Landeyran Valley, so that the lateral equivalents of the Couches du Landeyran inférieures may crop out there, although Thoral (1935*a* : 307) suggested that the species might occur in the Tremadoc Series, at which horizon he claimed to have found it in the Monts de Lacaune.

Discussion. *Ampyx priscus* was founded by Thoral on a number of syntypes, all of which were preserved in siliceous nodules as either internal or external moulds. Although this material had the advantage of being uncrushed, it comprised only disarticulated cranidia and pygidia ; nothing was known of the frontal spine, librigenae and hypostoma, but these have now been found near Le Foulon, though compressed to a greater or lesser degree in shaly mudstones. The glabella, excluding frontal spine, of the lectotype extends a little way in front of the fixigenae, but in specimens from near Le Foulon this feature is variable owing to crushing, so that the glabella may appear to end slightly behind or in front of the fixigenae (see Pls. 3, 4). The frontal spine has not been seen in its entirety, but its length was originally at least one and a half times that of the remainder of the glabella plus the occipital ring. The librigenae are narrow for the most part, broadening a little medially and produced posterolaterally to form a pair of long, curved, librigenal spines. The latter arch outwards and backwards, and their original length was at least four times that of the glabella, excluding frontal spine. They generally resemble the librigenal spines of *Ampyx virginiensis* Cooper (1953 : 16 ; Whittington 1959 : 465).

The hypostoma of *Ampyx priscus* is now known from one incomplete specimen and is almost as broad as long, excluding the anterior wings. The anterior margin arches gently forwards, is separated from the median body by a broad (*sag.*), shallow furrow, and extends laterally towards the incompletely-preserved anterior wings. Behind the last-named, the hypostoma is almost parallel-sided with a narrow, rim-like, lateral border, separated from the subcircular, gently convex median body by a conspicuous lateral border furrow. The posterior margin is convex backwards, well rounded, with a posterior border which is slightly broader (*sag.*) than the lateral border and also bounded by a well-defined furrow. The posterior and lateral borders fuse posterolaterally, the junction of the two being obtusely subangular.

For his description of the thorax of *A. priscus* Thoral (1935*a* : 306) had available a cephalon and pygidium, each with five attached segments, and the number of segments in the complete thorax could not be determined. Most of the new material does not show the thorax clearly but one specimen (Pl. 4, fig. 2), though poorly preserved, suggests that there are six segments, as in other species of *Ampyx*.

The type species of *Ampyx*, *A. nasutus* Dalman (see Whittington 1950 : 554) from the upper Arenig Series of Sweden, has a glabella not unlike that of *A. priscus*, but it is slightly broader frontally and projects farther forwards in front of the fixigenae, which are smaller and more triangular in plan. The pygidium of the Swedish species is also notably longer. *Ampyx linleyensis* Whittard (1955 : 20) from the lower Llanvirn Series of the Shelve Inlier has more complex glabellar lobation than *A. priscus*, and the fixigenae are narrower frontally. The hypostoma of *A. linleyensis* has been described (Whittard 1955, pl. 2, fig. 8) and differs markedly from that of the French species, having a more ovoid median body, narrowing posteriorly. In addition there are lateral indentations separating a pair of triangular posterior wings from anterior wings which are sited opposite the centre of the median body. The hypostoma of *Ampyx priscus* is closer to that of *A. virginiensis* Cooper (see Whittington 1959 : 468) but is more quadrate in plan and apparently lacks the anterolateral expansions of the American species. The Swedish Arenig species *Ampyx obtusus* Moberg & Segerberg (1906 : 100 ; see also Tjernvik 1956 : 271) has fixigenae closely similar to those of *A. priscus*, but the glabella is slightly shorter and narrower whilst the pygidium is longer and smoother with a more angular margin.

Another raphiophorid described from the Montagne Noire is *Ampyx? villebruni* Thoral (1935*a* : 307), from the Arenig of the St. Chinian district. The species is unusually small and needs to be redescribed, but its affinities appear to lie with such genera as *Ampyxina* and *Orometopus* rather than with *Ampyx.*

Family **TRINUCLEIDAE** Hawle & Corda 1847

Subfamily **HANCHUNGOLITHINAE** Lu 1963

Genus ***HANCHUNGOLITHUS*** Lu 1954

Hanchungolithus primitivus (Born)

(Pl. 5, figs. 1–9)

1921. *Trinucleus primitivus* Born : 191, fig. 1.
1927. *Cryptolithus primitivus* (Born) Stetson : 89, 92.
1935. *Trinucleus primitivus* Born ; Thoral : 175.
1957. *Myttonia primitiva* (Born) Whittard : 267, pl. 1, figs. 1–5.
1963. *Hanchungolithus primitivus* (Born) Lu : 338.
1964. *Hanchungolithus primitivus* (Born) ; Lu : 293.

Figured material. Brit. Mus. (Nat. Hist.) In.56534 (Pl. 5, figs. 2, 5) ; In.56551 (Pl. 5, fig. 1) ; In.57935 (Pl. 5, fig. 4) ; In.57939 (Pl. 5, fig. 7) ; In.58591 (Pl. 5, fig. 3) ; In.58594 (Pl. 5, fig. 9) ; In.58596 (Pl. 5, fig. 6) ; In.58600 (Pl. 5, fig. 8).

Localities and horizons. Born's type material must have been obtained from the roadside exposure in the southern part of the Landeyran Valley denoted here by the symbol $\lambda 17$ (see Text-fig. 3). Although not particularly common at this point the species is much more abundant at numerous other places in the vicinity, and localities $\lambda 19$ and $\lambda 20$ proved especially fruitful. All are in the Couches du Landeyran supérieures, for which subdivision *H. primitivus* is taken as the guide fossil. The best development of these strata is in the southern part of the Landeyran Valley, and there is an apparent thinning north-eastwards owing to overstep at the base of the succeeding Devonian rocks (see Text-fig. 8). As noted earlier, several specimens housed in old collections at Montpellier University were obtained from the Boutoury district, near Cabrières, some 25 km. east-north-east of the Landeyran Valley.

Discussion. Whittard (1957) has given a detailed description of *H. primitivus* to which little need be added. The thorax is known now to comprise the normal trinucleid complement of six segments, and has been found enrolled with the posterior margin of the pygidium abutting against the inner margin of the ventral lamella of the cephalic fringe. Although Whittard ascribed Born's species to his own genus *Myttonia*, from the early Arenig Series of the Shelve Inlier, I agree with Lu (1963 : 338) that it is better placed in *Hanchungolithus*. The cephalic fringe of *Myttonia confusa*, the type species (see Whittard 1955 : 29, pl. 3, figs. 5–7), carries a large number of pits, randomly arranged and of almost uniform size, and thus contrasts markedly with those of *Hanchungolithus multiseriatus* Endo sp. (see Lu 1957, pl. 155, figs. 5–7 ; 1963 ; 1964) and *H. primitivus*. Both these species have a frontal group of large pits with fairly regular radial and concentric arrangement, of which the outermost concentric row is continued anterolaterally, though composed there of slightly smaller pits, less regularly disposed. The remainder of the fringe is covered with innumerable, very small pits and there is no trace of regular arrangement. *H. primitivus* bears a remarkable resemblance, and is certainly related, to *H. multiseriatus*, but the two can be distinguished and I disagree with Lu's assertion (1964 : 293) that they are probably synonymous. The cephalic fringe of *H. multiseriatus* is broader (*sag.*) frontally than that of *H. primitivus*, and although adult specimens of both species have two concentric rows of large pits, I_1 and I_2, at the sagittal line, in the Chinese species a third concentric row is strongly developed between I_1 and I_2, generally at about R_2 or R_3. The corresponding row of *H. primitivus* does not appear until about R_5 or R_6 and is made up of relatively smaller pits. One of Lu's specimens (1964, pl. 2, fig. 6) shows a number of large pits arranged in four to five concentric rows at least from about R_6 to R_9, but the corresponding features are much less well developed in *H. primitivus*. Judging from the illustrations, the thickened rim of the cephalon is broader and more strongly developed in *H. primitivus*, the alar lobes are more distinct, and the numerous pits covering the greater part of the cephalic fringe are generally smaller and more closely-grouped than those of *H. multiseriatus*. The pygidium is broadly similar in both species, with the side-lobes ornamented by only one or two pairs of furrows. The axis of *H. multiseriatus* is, however, better segmented with three axial rings well defined and another three less so, whilst that of *H. primitivus* has only two clearly marked rings followed by traces of others.

Several immature specimens of *Hanchungolithus primitivus* have been collected, but as they are all disarticulated fragments, mostly cephala or cranidia, it is difficult to assign them to their appropriate stages of development. One of the smallest available is an incomplete cephalon (Pl. 5, fig. 8) with an estimated length and breadth (excluding librigenal spines) of 3·8 mm. and 1·2 mm. respectively. The margin is thickened, especially anterolaterally, and continues in an unbroken line along the spines, which are stouter and more splayed backwards than in the adult. Alar lobes are well developed, and from the outer end of the short (*tr.*), left ocular ridge runs a single nervure, represented by a thin raised ridge directed towards the genal angle. A similar structure on a much larger individual has been figured by Whittard (1957, pl. 1, fig. 3). This small specimen corresponds in size with Lu's interpretation (1964, pl. 2, fig. 3) of Meraspis Degree 3 in *Hanchungolithus multiseriatus*, but exhibits less mature characters. Several developmental stages were illustrated by Lu (*loc. cit.*) but all lack the associated thorax and pygidium, so there must be some doubt as to their status. A cephalon of *H. primitivus* (Pl. 5, fig. 1) 5·0 mm. wide and 1·9 mm. long has distinct alar lobes 0·5 mm. long, separated by broad alar furrows, and short (*tr.*), transversely straight ocular ridges sited a little in front of centre of the glabella. This specimen is only slightly larger than Meraspis Degree 4 of *H. multiseriatus* as figured by Lu (1964, pl. 2, fig. 4) but has better developed alar lobes and a thicker margin. There seems also to be a smaller development of fringe pits frontally, but this part of the cephalon is difficult to interpret from the published photograph. Another cephalon of similar size (Pl. 5, fig. 6) is relatively longer, with breadth 5·2 mm. and length 2·2 mm., though this may be due to crushing. The thorax of this specimen is slightly disarticulated but, showing four segments, probably represents Meraspis Degree 4, and has a pygidium which is longer and more angular posterolaterally than that of the adult trilobite. Pl. 5, fig. 7 shows a cephalon 6·0 mm. broad and 2·4 mm. long which has swollen, oval alar lobes and noticeably short (*tr.*) ocular ridges directed slightly backwards abaxially. The specimen is slightly larger than the supposed Meraspis Degree 5 of *H. multiseriatus* (see Lu 1964, pl. 2, fig. 5), and differs from the latter in having thicker, less transverse ocular ridges, and considerably more conspicuous alar lobes.

Family **PLIOMERIDAE** Raymond 1913

Subfamily **PLIOMEROPSINAE** Raymond 1913

Genus ***PLIOMEROPS*** Raymond 1905

It was stated by Harrington (*in* Moore 1959 : O 439 *et seq.*) that the cephalon of *Pliomera* differs from that of *Pliomerops* in having an indented frontal glabellar lobe, a denticulated anterior border, a gonatoparian facial suture (as opposed to proparian in *Pliomerops*), and small eyes sited posteriorly rather than medially. In the same publication, however, he departed slightly from this definition by including within *Pliomerops* the Bohemian species *P. senilis* (Barrande), in which the eyes are placed notably far forwards. This last feature also characterizes the only representative of the Pliomeridae found in the Montagne Noire, and it is preferred here to extend the limits of the diagnosis of *Pliomerops* so as to include such forms.

Pliomerops escoti (Bergeron)

(Pl. 6, figs. 1–4, 6, 8–10)

1895. *Amphion escoti* Bergeron : 472, pl. 4, figs. 6–8.
1941. *Amphion escoti* Bergeron ; Thoral : 142, pl. 1, figs. 1–4. Includes full synonymy of the species.

Figured material. Brit. Mus. (Nat. Hist.) I.15877 (Pl. 6, fig. 4) ; I.15878 (Pl. 6, figs. 6, 8, 10) ; It.158 (Pl. 6, figs. 1, 2) ; It.159 (Pl. 6, fig. 3) ; It.161 (Pl. 6, fig. 9).

Localities and horizons. All the specimens collected here are from locality λ2, in the river bank near the northern end of the Landeyran Valley. The rocks form part of the Couches du Landeyran inférieures. The two figured specimens from the Escot Collection (Pl. 6, figs. 4, 6, 8, 10) are not precisely localized within the same valley, but judging from their state of preservation they derive from a similar horizon and, possibly, locality. Bergeron's type material came from near Cabrières, presumably from an horizon at least approximating to that of the Couches du Landeyran inférieures.

Description. The cranidium is almost three times as broad as long. The glabella, with length and breadth about equal, is only gently convex both longitudinally and transversely, though the actual amount may be obscured by slight dorsal compression when preserved in an argillaceous matrix. The glabellar outline is sub-pentagonal, bluntly pointed frontally, the gently curved sides slightly divergent forwards, with minor indentations at the outer ends of the glabellar furrows. There are three pairs of glabellar lobes, delimited by pairs of glabellar furrows which extend inwards on either side for about one-third of the breadth of the glabella, leaving a smooth median band. The third glabellar furrows are moderately impressed, arching inwards and back so as to end opposite the mid-points of the third glabellar lobes. The second and third pairs of furrows are parallel to one another, and the second lobes are similar in size to those of the basal pair. The first glabellar furrows are situated well forwards, just behind the mid-points of the anterolateral margins of the glabella. In consequence the frontal glabellar lobe is very small, at first expanding forwards and then contracting to a blunt point frontally, with maximum breadth less than half that of the glabella. The first glabellar lobes are subpentagonal in plan, their long axes widely divergent forwards and with their pointed apices situated at the intersection of the axial furrows, lateral border furrows and preglabellar furrow. The first glabellar furrows extend inwards a shorter distance than those of the other pairs, though ending longitudinally in-line with them, and become noticeably shallower over their length (*tr.*), unlike the other glabellar furrows which are of more even depth. The anterior border is of uniform breadth (*sag.*), equal to about one-eleventh of the glabellar length (*sag.*), and arched forwards parallel to the front of the glabella. There is no clear differentiation of preglabellar furrow, preglabellar field and anterior border furrow, and the anterior border is separated from the glabella by a uniformly broad furrow, sub-quadrate in cross-section. Overall the axial furrows are gently convex outwards, converging a little at each glabellar furrow so that the tips of the glabellar lobes are, in turn, slightly convex in plan. The lateral border, though not well known, is well developed and bounded by a strong lateral border furrow. The occipital ring is longest (*sag.*) medially, slightly less than one-fifth the length of the glabella, its posterior margin almost straight but the anterior margin arched forwards, ending laterally in a pair of widely divergent occipital lobes. The pleuroccipital segment is transversely straight and ridge-like as far as the fulcra, coincident with a deep, narrow (*exsag.*), pleuroccipital furrow. Beyond the fulcra the pleuroccipital segment widens (*exsag.*) at first but then narrows to the rounded genal angles, whilst the pleuroccipital furrow becomes broader and shallower, finally curving forwards to join the lateral border furrows. The eyes are sited in a conspicuously forward position, opposite the posterior halves of the first glabellar lobes. The outer margins of the palpebral lobes are almost straight, running outwards and backwards at about 45° so that the visual surfaces, which have not been found preserved, must have faced anterolaterally. The posterior halves of the palpebral lobes are thickened slightly and the lobes themselves are defined by sharply incised palpebral furrows, the hindmost parts of which turn outwards and die out. Frontally the palpebral furrows end a short distance from the lateral border furrows, but the posterior edges of the latter furrows are reached by the forward continuation of the palpebral lobes as eye-ridges which are then flexed adaxially. The fixigenae are of notably large size, though the foremost portions are conspicuously small between the palpebral lobes and the axial furrows. The anterior branches of the facial suture run sharply inwards from the eyes to cut the lateral border furrows and the outer ends of the anterior border. The posterior parts of the fixigenae are broad (*exsag.*) and the posterior branches of the facial suture are widely and uniformly arched backwards to the genal angles. The surface of most of the cephalic test, excluding furrows, is finely granulated, but that of the fixigenae is pitted.

In his description of the species Thoral (1941 : 145) did not describe or figure the hypostoma which, he said, was incompletely known. A single hypostoma of cheirurid type was found in the Landeyran Valley in association with other known fragments of *Pliomerops escoti*, and in the absence of other more suitable contenders it is provisionally assigned to that species (see Pl. 6, figs. 1, 2). The overall outline is subrectangular, the maximum breadth about three-quarters of the median length, and the entire hypostoma is only gently convex, both longitudinally and transversely. The median lobe is almost oval in plan, its breadth a little less than the length. The median furrow is developed only laterally, the two furrows so formed running adaxially backwards from the lateral border furrows and becoming progressively shallower until they are finally obsolete, leaving the median third of the hypostoma unfurrowed. The length of the median body, as measured from the inner ends of the two parts of the median furrow, is slightly less than two-thirds of the total length of the hypostoma. The anterior border forms a narrow rim, ventrally concave, its margin well rounded in plan and continuing laterally to form the curved anterior margins of the anterior wings. The latter have almost transversely straight posterior margins and are strongly deflected dorsally. The lateral borders are longitudinally straight, more strongly developed than the anterior border, and arise from immediately outside the outer ends of the median furrow. They are delimited adaxially by furrows, which are deep frontally but become shallow posteriorly, and coalesce with the broad, posterior border furrow. The posterior border forms a rim, broader (*sag.*) and more strongly curved than the anterior border, and its junction with the lateral borders is marked by a pair of small marginal spines, directed backwards abaxially and corresponding in position to posterior wings. The posterior lobe is subcrescentic in outline, arching forwards anterolaterally but confluent over its median third with the anterior lobe. The incompletely preserved external mould shows that at least part of the ventral surface of the median body was covered with thin, raised, anastomosing ridges forming a Bertillon pattern, whilst the lateral borders and posterolateral marginal spines carry thicker terrace lines.

On the basis of material from the Cabrières district it is known that the thorax of *Pliomerops escoti*, like that of *P. senilis* (Barrande), contains only fourteen segments. The axis is relatively narrow, only about one-quarter of the thoracic breadth, and stands slightly higher than the side-lobes. The axial rings are transversely straight over most of their length (*tr.*), but the outer ends form a pair of small axial lobes, directed anterolaterally. Each pleura is flat for about half its length (*tr.*) as far as the fulcrum, but then becomes moderately declined. It is divided into two bands of which the posterior is the larger and more conspicuous, thickened so as to form a prominent ridge. This is uniformly developed as far as the fulcrum but then gradually diminishes as it follows the curved posterior margin of the outer part of the pleura, finally dying out before reaching the pleural tip. There is a trace of a narrow (*exsag.*) posterior flange immediately behind the posterior band. As the posterior band narrows beyond the fulcrum, so the anterior band broadens and is deflected ventrally to form an articulating facet. The pleural tip is bluntly pointed.

The pygidium, excluding the articulating half-ring, has a median length just over two-thirds of the maximum breadth. The axial outline is that of an acute isosceles triangle, equal to about three-quarters of the total pygidial length and with slightly convex sides converging backwards at about 40° to the sharply-pointed tip. There are five well-defined axial rings, separated from one another by deep, broad (*sag.*) ring furrows. The first ring is arched forwards slightly in plan, but the other rings become progressively less so, and the fifth is transversely straight. The terminal piece is conspicuously triangular, and the axial furrows are deep, wide and almost straight. The pleural regions comprise five pairs of pleurae, each ending posterolaterally in a pair of long free points. The first pair of pleurae run outwards and slightly backwards for about one-third of their length (*tr.*) but then flex sharply backwards, continuing as slender free points and diverging at about 40°. The remaining pairs of pleurae become progressively less flexed but more strongly directed backwards, until the hindmost pair run parallel to each other and extend beyond the tip of the axis.

A single specimen of a transitory pygidium (see Pl. 6, fig. 9) was collected in the Landeyran Valley. Six axial rings and pleurae are present, and presumably Meraspis Degree 13, is represented. The pygidium differs also from that of a typical holaspis in being slightly broader, and in having an axis with a less triangular outline, and the free points of the pleurae directed less strongly backwards.

Discussion. Specimens of *Pliomerops escoti* from the Montagne Noire have often been referred to *Pliomerops* [*Amphion*] *lindaueri* Barrande sp. (1852 : 820, pl. 30, figs. 12, 13). The latter species was described from only a single pygidium, preserved as an internal mould and now in the National Museum, Prague (number ČD. 142). Dr. R. Horný kindly informs me that the specimen is from the Arenig Series at Komárov, Bohemia, a locality now no longer available. Judging from the holotype, *Pliomerops lindaueri* is probably a larger species than *P. escoti*, but the two are of generally similar type, at least as far as the pygidium is concerned. However, the pygidial pleurae and pleural spines are turned backwards more sharply in *P. escoti*, so that the line of maximum pygidial breadth is sited farther back than in *P. lindaueri*. Thoral's comparison (1941 : 146) of the cephalon of *P. escoti* with that of *P. lindaueri* must be disregarded as the latter has yet to be described.

Pliomerops escoti differs in several respects from the type species of the genus, *P. canadensis* (Billings), which has been discussed and refigured by both Cooper (1953 : 26) and Whittington (1961 : 917). The second and third glabellar furrows of *P. escoti* curve backwards more strongly, the third glabellar lobes are larger, and, as noted earlier, the eyes are sited close to the glabella and well forwards, opposite the posterior half of the first glabellar lobes. This last contrasts sharply with the position of the eyes in *P. canadensis*, about midway between the axial furrows and the cephalic margin, and opposite the posterior half of the second glabellar lobes. The hypostoma of *P. canadensis* (see Whittington 1961, text-fig. 2C, pl. 101, fig. 19), roughly ovoid in plan with broad, continuous lateral and posterior borders, is quite unlike that tentatively assigned to *P. escoti*.

The species most obviously related to *Pliomerops escoti* is *P. senilis* (Barrande 1872 : 118) from the Šárka Beds (Llanvirn Series) of Osek, Bohemia, which is generally similar and shares with it the unusually anterior position of the eyes. *P. senilis* is a large species, probably larger than *P. escoti*, with straighter, more divergent axial furrows and smaller third glabellar lobes, whilst the palpebral lobes run more strongly backwards abaxially. The hypostoma of *P. senilis* differs from that assigned to *P. escoti* by being divided into two subequal parts by the median furrow, having a broader border, and lacking the spinose posterior wings of the French species. The two pygidia are superficially similar but that of *P. escoti* has a narrower axis and slimmer pleurae which flex backwards more strongly.

Family **CHEIRURIDAE** Salter 1864

Subfamily **CHEIRURINAE** Salter 1864

Genus ***CERAURINELLA*** Cooper 1953

Ceraurinella peregrinus sp. nov.

(Pl. 6, figs. 5, 7 ; Pl. 7, figs. 1–9)

Diagnosis. *Ceraurinella* with glabella well rounded frontally and almost parallel-sided. Three pairs nearly equidimensional glabellar lobes present ; basal pair delimited by basal glabellar furrows which become shallower posteriorly to occipital furrow. Anterior border narrow (*sag.*), steeply upturned. Eyes opposite second glabellar furrows. Glabellar surface granulated, that of fixigenae pitted. Genal angles forming short fixigenal spines. Thorax of eleven segments, ending laterally in long, free spines. Posterior margin of pygidium with three pairs unequal spines which become progressively shorter from first to third, those of first pair conspicuously larger than others.

Holotype. Guiraud Coll., University of Montpellier (Pl. 7, figs. 1–3, 6, 7).

Paratypes. Guiraud Coll., University of Montpellier (Pl. 7, fig. 4 and Pl. 7, figs. 8, 9) ; Brit. Mus. (Nat. Hist.) It.160 (Pl. 7, fig. 5) ; It.169 (Pl. 6, figs. 5, 7).

Localities and horizon. The material at Montpellier University is stated to be from " Le Foulon ", and its state of preservation matches that of the strata at the hillside section about 250 metres south-west of Le Foulon. Specimen It.169 is from $\lambda 32$ at the same section, whilst It.160 is from $\lambda 2$ near the northern end of the Landeyran Valley. In all cases the horizon either is, or is presumed to be, in the Couches du Landeyran inférieures.

Description. The cranidium has been found reasonably preserved in only two small specimens, one from the northern end of the Landeyran Valley and the other from the area south-west of Le Foulon. Both are incomplete and slightly damaged but, as far as can be judged, the glabella is moderately convex, slightly longer than broad, almost parallelsided, narrowing a little from the occipital furrow to just behind the first glabellar furrows, and well-rounded frontally. There are three pairs of glabellar lobes, almost equal in size and each about one-quarter of the glabellar length. Those of the third pair approach the " cat's ear " outline, each being generally subcircular with an angular projection directed anterolaterally towards the axial furrow. Their distal margins are slightly convex beyond the otherwise straight sides of the glabella. The third glabellar furrows are deep, running inwards and moderately backwards from the axial furrows for three-quarters of the breadth of the basal lobes and then turning through about 60° so as to run almost straight backwards to the occipital furrow, at the same time becoming markedly shallower. The second glabellar lobes are subrectangular in plan, slightly longer (*tr.*) than those of the first pair and occupying about one-third the glabellar breadth. The second glabellar furrows run inwards and slightly backwards from the axial furrows, curving gently and becoming a little shallower towards their inner ends. The first glabellar furrows are similar to the second furrows, though perhaps a little shorter (*tr.*) as far as can be seen, and the first and second glabellar lobes are of approximately similar size. The frontal glabellar lobe is semi-elliptical in plan, three times as broad as long, broadly convex frontally and curving smoothly backwards to the first glabellar furrows, the anterolateral angles of the glabella being well rounded. The axial furrows are almost straight overall with only a slight outward curvature posteriorly to accommodate the third glabellar lobes. Frontally they are continuous with the deep, narrow, preglabellar furrow circumscribing the frontal glabellar lobe. The anterior border forms a narrow (*sag.*), steeply upturned brim running subparallel to the front of the glabella, from which it is separated by a deep furrow. The last-named widens (*exsag.*) a little abaxially towards its junction with the axial furrows opposite the first glabellar furrows. The upper part of the anterior border is slightly thickened so that it appears superficially to be separated from the glabella by a narrow (*sag.*) preglabellar field, but no anterior border furrow is developed. The furrow separating the anterior border and the frontal glabellar lobe continues laterally beyond the axial furrows so as to form a deep depression between the ends of the anterior border and the narrow, declined, frontal portions of the fixigenae, and opposite the outer ends of the first glabellar furrows. The occipital ring and furrow, though incompletely preserved, appear to be transversely straight medially, and curve forwards slightly at their outer ends, where the occipital ring is a little narrower (*exsag.*). The pleuroccipital segment is narrower (*exsag.*) immediately outside the axial furrows but increases uniformly in breadth towards the genal angles which are produced to form a pair of short, stout, fixigenal spines, directed posterolaterally. The pleuroccipital furrow is deep and narrow near the axial furrows but widens noticeably towards the genal angles, where it curves forwards, turning through more than a right angle to join the lateral border furrows. One of the paratypes (Pl. 6, figs. 5, 7) shows a small lateral projection on the left margin of the cephalon just in front of the line of the pleuroccipital furrow, but there is insufficient evidence to show whether a pair of true marginal spines (profixigenal spines of Harrington *in* Moore 1959 : O 53) is present. Owing to crushing, the exact position of the eyes is a little difficult to judge, but they apparently occupy a position opposite the second glabellar furrows, the anterior part of the second glabellar lobes, and probably also the hindmost part of the first glabellar lobes. Only the left palpebral lobe is known, which is narrow, prominent, ridge-like and runs abaxially backwards. There is a deep, narrow, palpebral furrow which widens and dies out to both front and back. The anterior branches of the facial suture are slightly convergent forwards, sub-parallel to the axial furrows. The posterior branches run almost straight outwards from the palpebral lobes as far as the lateral border furrow, where they begin to curve gently back, cutting the lateral margins approximately in-line with the anterior ends of the third glabellar furrows. With the exception of the smooth furrows, the surface of the glabella is covered with fine, evenly-distributed granules, among which are slightly larger, less crowded tubercles. The surfaces of the lateral border, pleuroccipital segment and fixigenae are all finely granulated but the granulation of the fixigenae is accompanied by pitting which is particularly conspicuous postero-laterally. The fine granulation traverses the lateral border furrows but is less well developed there.

The hypostoma is known from a single, indifferently-preserved specimen, an external mould forming part of the holotype. The anterior border is not preserved, but was probably gently convex forwards. The original outline of the hypostoma was semi-elliptical, with the median length about equal to the maximum breadth, excluding the anterior wings which are broken off. The median body is moderately plump and stands a little higher than the lateral borders. In plan it is roughly pear-shaped, narrowing backwards, but owing to crushing it is not clear whether the posterolateral indentations are, in fact, a primary feature. The posterior border is narrow (*sag.*) medially (probably less than one-sixth of the total original length) and confluent with the lateral borders which are slightly broader, especially frontally, near the conjectured position of the anterior wings. The entire border forms a collar-like structure which declines inwards, particularly anteriorly, and is separated from the median lobe by a broad border furrow. Fine granules cover the surface of the median body and most of the border, but the deepest parts of the border furrow are smooth.

The thorax comprises eleven segments, the axis being moderately convex and standing higher than the side-lobes. The median part of each axial ring is transversely straight but the ends curve forwards slightly so as to form a pair of axial lobes, poorly defined on the external mould but quite distinct, and preceded by a pair of apodemes, on the internal mould. The axis occupies about one-quarter of the thoracic breadth and is separated from the side-lobes by well-defined axial furrows which are slightly indented by the abaxial margins of the axial lobes. The articulating half-rings are well developed, each separated from the axial ring by an articulating furrow which curves slightly forwards medially. From the axial furrows the adaxial portions of the side-lobes are flat as far as the fulcra, beyond which they are slightly declined. In plan view each segment is parallelsided and curves gently back as far as the fulcrum. From the internal mould it is apparent that the thoracic doublure was relatively wide, reflexed ventrally so as to end just outside the line of the fulcrum, the distance from the pleural tip to the inner margin of the doublure being approximately one-fifth of the thoracic breadth. Beyond the fulcrum the tip of each pleura is produced to form a long, slender, free spine. The posterior margin of each pleura curves gently forwards and outwards from the fulcrum and then backwards, whilst the anterior margin curves backwards evenly and more strongly from the fulcrum to the pleural tip. The first pleural spines curve backwards only slightly, but succeeding pairs become progressively more strongly curved. The slight backward projection of each pleura at the fulcrum indicates the position of a socket which articulated with a corresponding process on the anterior margin of the succeeding pleura. The test of the thorax is almost smooth and a few minor patches of pitting are believed to be due to the state of preservation.

The pygidium is relatively large and of depressed form, its length estimated to be about one-third that of the whole exoskeleton. Its frontal margin is transversely straight, occupying about half the breadth of the posterior part of the thorax, with which it articulates by means of a pair of small bosses sited anterolaterally. The pygidium is made up of three segments, ending in markedly unequal pairs of marginal spines which occupy virtually the entire lateral margin. The axis occupies one-third of the frontal breadth of the pygidium, about two-thirds its median length (excluding the marginal spines), and tapers strongly backwards. The axial furrows are well defined frontally but become shallower posteriorly. The first two axial rings are transversely straight and well defined, but the third ring is less distinct. The first pair of marginal spines are conspicuously large and straight-sided, their long axes diverging posteriorly at about 40°. Some of the material shows longitudinal grooves running along each spine, but these are asymmetrical and the result of crushing. The marginal spines of the second pair are slightly flattened, about one-third the size of the first pair, and only slightly divergent backwards. They are separated from the first marginal spines by broad, gently curved, shallow furrows. The third pair of marginal spines appear as continuations of the third axial ring, turning backwards through a right-angle and then running parallel to one another. They are rather less than half the length of the second pair of spines and more pointed. As far as can be judged from the rather compressed material, the first pair of pygidial spines are probably moderately inclined posteriorly, whilst both the second and third pairs are horizontal or nearly so. The second and third ring furrows of the axis are continued just beyond the axial furrows so as to form slightly elongated, pit-like depressions followed by broad, shallow grooves separating the second and third pairs of spines. The area between the third ring furrow and the posterior margin of the pygidium is slightly convex, but there is no postaxial ridge.

DISCUSSION. *Ceraurinella peregrinus* is the earliest known representative of the genus, and the only one yet described from the Arenig Series. Previously *Ceraurinella* has been found only in the Middle Ordovician (about early Caradoc Series) of North America, though Männil (1958 : 173–175, 206–207) has recorded it tentatively from slightly earlier Ordovician strata in the East Baltic region. The type species of the genus is *Ceraurinella typa* Cooper (1953 : 28–30, pl. 12, figs. 1–5, 7–8, 15–16), described originally from the Edinburg Limestone of Virginia. Cooper's type material was silicified and undistorted, so that it is impossible to make a detailed comparison of the two species in all respects. The glabellar furrows of silicified *C. typa* appear shorter (*tr.*) than those of the French species (see Cooper 1953, pl. 12, figs. 1, 3, 8 ; also Whittington & Evitt 1954, pl. 10, figs. 3, 5, 11, 12 ; pl. 13, fig. 3) but those of a crushed cephalon preserved in what was described as a "silty layer" appeared longer (*tr.*) (see Cooper 1953, pl. 12, figs. 15, 16). This variation in the length of the furrows according to preservation may be analogous to the greater length of those in *C. peregrinus*, preserved in an argillaceous matrix. Strong eye-ridges such as are developed in *Ceraurinella typa* have not been found in *C. peregrinus*. The pygidia of the two species are generally similar, but the first pair of spines are slightly less divergent in *C. peregrinus*, and the second and third axial rings are less arched in plan, ending posteriorly in spines conspicuously longer than the corresponding structures in *C. typa*.

Harper (*in* Harper & Rast 1964 : 16, pl. 2, fig. 3) has figured from the Llanvirn Series of eastern Ireland an incomplete cheirurid cranidium which he refers to the genus *Paraceraurus* Männil. The type species, *Ceraurus aculeatus* Eichwald 1860, from the Kuckers Stage of Estonia, has been described and illustrated by both Öpik (1937 : 95, pls. 13, 17–19) and Männil (1958 : 172, 206, pl. 1, fig. 1) whose photographs show certain differences from the Irish form, in which the fixigenae are narrower and the eyes are set closer to the glabella, with well developed eye-ridges running from them to the axial furrows. Harper's material is compressed and slightly distorted, and the cranidium might equally well be compared with that of *Ceraurinella*. Harper refers to, but does not figure, a pygidium said to have long first paired pleural spines, followed by two pairs of smaller spines, the third pair being longer than the second pair. There is no mention in his reference of a terminal spine such as occurs in *Paraceraurus aculeatus*, and additional material would be needed to assess accurately the systematic position of the Irish species.

Reraspis plautini (Schmidt), also from the Kuckers Stage of Estonia, has been illustrated by Öpik (1937 : 105, pl. 11, figs. 1–5). The cephalon is broadly similar to that of *Ceraurinella*, whilst the pygidium ends in three pairs of spines, though only slightly unequal in size and lacking the extravagant development of the first pair of spines as found in *Ceraurinella*. One of the pygidia illustrated by Öpik shows the tips of the pygidial spines stepped forwards slightly from first to third, but on another of his specimens the reverse is apparently the case. An interesting feature of *R. plautini* is the overall resemblance of the hypostoma to that of *Ceraurinella peregrinus*. Both are subtriangular in plan, the lateral and posterior margins joining to form a smooth, almost parabolic curve, inside of which the median body is unfurrowed and suboval in outline. The single, damaged specimen of the hypostoma of the French species makes detailed comparison difficult, but the median body appears to be relatively a little larger, and perhaps less convex frontally. As noted earlier, the posterolateral indentations of the median body in this specimen are probably secondary.

The trilobite described from the Niti region of the Northern Himalaya by Salter (*in* Salter & Blanford 1865 : 6, pl. 1, figs. 14–18) as *Cheirurus mitis*, and later redescribed in greater detail by Reed (1912 : 106, pl. 15, figs. 10–24), has more recently been assigned to *Ceraurinella* by Kobayashi (1960 : 46). The cranidium of the Himalayan species differs from *C. peregrinus* in having the eyes sited a little farther back, opposite the second glabellar lobes, whilst the glabellar furrows are more transversely straight, a feature in which they more resemble those of *Ceraurinella typa*. In addition, the hindmost median portion of the glabella of *Ceraurinella mitis* is slightly raised and forms a conspicuous ridge-like feature, standing a little higher than the occipital ring. This ridge appears to be a primary feature of the species and not due to distortion. The pygidium of *C. mitis* resembles that of *C. typa* in having three unequal pairs of pleural spines similarly disposed, but the large spines of the first pair are more curved in *C. mitis* than in either *C. typa* or *C. peregrinus*, whilst the second pair are proportionately smaller and less flattened than in the French species, and appear to be shorter than the third pair. Kobayashi (1960 : 46) has also described *Ceraurinella* cf. *mitis* from the Ordovician of Viet Nam, and the group appears to have been very widely distributed during Ordovician times. The Asian occurrences, like those in North America, are almost certainly considerably younger than the specimens from the Montagne Noire.

Family **DALMANITIDAE** Vogdes 1890

Subfamily **ZELISZKELLINAE** Delo 1935

Genus ***ORMATHOPS*** Delo 1935

Ormathops borni sp. nov.

(Pl. 8, figs. 1–8 ; Pl. 9, figs. 1–13)

DIAGNOSIS. *Ormathops* with sub-semicircular cephalon ending posterolaterally at genal angles carrying small fixigenal spines in immature specimens but subangular in adult stages. Glabella pentagonal in plan with transversely lozenge-shaped frontal lobe produced laterally beyond first glabellar lobes. Three pairs well-defined glabellar furrows, third pair deepest with apodemes. Glabella separated by narrow furrow from anterior border which carries frontal extension of facial suture. Palpebral lobes laterally convex, extending from axial furrows opposite first glabellar furrows until opposite middle of second glabellar lobes. Test of cheeks pitted, remainder of cephalon finely granulated. Pygidium subtriangular with short, slightly convergent axis followed by long postaxial ridge. Six axial rings present, the last two poorly defined. Side-lobes with three pairs ribs and trace of fourth pair.

Holotype. Brit. Mus. (Nat. Hist.). In.57447 (Pl. 9, figs. 4, 9, 10).

Paratypes. In.56557 (Pl. 8, fig. 8); In.56609 (Pl. 9, fig. 3); In.56613 (Pl. 9, fig. 2); In.56614 (Pl. 8, fig. 7); In.56620 (Pl. 8, figs. 1, 6); In.57446 (Pl. 9, fig. 13); In.57447 (Pl. 9, figs. 4, 9, 10); In.57448 (Pl. 8, figs. 2–4); In.57772 (Pl. 9, fig. 1); In.57898 (Pl. 9, figs. 5, 12); In.57953 (Pl. 9, fig. 11).

Other figured material. In.56588 (Pl. 9, fig. 7); It.285 (Pl. 8, fig. 5); It.286 (Pl. 9, figs. 6, 8).

Localities and horizons. All the type material was collected from locality λ16, the section by the south-eastern side of the road (Route D.136), near the southern end of the Landeyran Valley. Here and in the immediate vicinity *Ormathops borni* occurs in the Couches du Landeyran supérieures but does not range upwards into the highest strata of that subdivision. The species occurs rarely in the Couches du Landeyran inférieures and only a single cranidium and pygidium were found at locality λ33 in the hillside section 240 metres south-west of Le Foulon.

Description. The cephalon is sub-semicircular in plan, with median length slightly greater than half the maximum breadth, and only moderately convex both longitudinally and transversely. The glabella is subpentagonal in outline, broadly rounded frontally, with its maximum breadth, as measured across the frontal glabellar lobe, equal to the median length and twice the basal breadth. The frontal glabellar lobe is transversely almost lozenge-shaped and occupies about half of the glabellar length. There are three pairs of glabellar lobes, decreasing in size from first to third. The first glabellar lobes are subtriangular in outline, expanding abaxially until equal to about one-quarter of the length of the glabella. They are separated from the frontal glabellar lobe by shallow first glabellar furrows which diverge forwards at about 130° and deepen slightly near their outer ends. The second glabellar lobes are about two-thirds the size of the first lobes, subrectangular in plan and separated from the first lobes by deep, transversely straight, second glabellar furrows extending inwards almost one-third of the breadth of the glabella. The third glabellar lobes are shorter (*tr.*) than those of the second pair, subcircular in plan, expanding slightly outwards, and about one-seventh of the length of the glabella. The third glabellar furrows run inwards and slightly backwards from the axial furrows, expanding at their inner ends, where a pair of apodemes is situated. The axial furrows are almost straight, diverging forwards at 20–25° for the most part, but are " stepped " slightly outwards so as to accommodate the frontal glabellar lobe, which projects laterally a short distance beyond the second glabellar lobes. There is also a small break in the axial furrows opposite the middle of the second glabellar lobes, the furrows being slightly more divergent forwards in front of this point. The anterior border is narrow (*sag.*), declined frontally, with gently rounded dorsal surface, and separated from the glabella by a broad (*sag.*), shallow furrow which circumscribes the frontal glabellar lobe. The border becomes slightly broader (*exsag.*) at the line of the axial furrows before narrowing again beyond them and coalescing with the lateral border to form a thickened rim extending backwards to the genal angles. The occipital ring is transversely straight and parallelsided over most of its length (*tr.*) but the ends become narrower (*exsag.*) and are developed as a pair of occipital lobes, directed anterolaterally. The occipital furrow is straight, deepening distally to a pair of apodemes. The pleuroccipital segment is narrow (*exsag.*) at the axial furrows but widens abaxially, especially beyond the fulcra, towards the genal angles where it merges with the lateral border. The genal angles are typically subangular in the largest cephala, but those of immature individuals (see p. 296) carry fixigenal spines which become progressively smaller as the size of the cephalon increases. Excluding those portions adjacent to the palpebral lobes, where they are slightly declined adaxially, the inner halves of the cheeks are almost level. The outer halves decline towards the broad, shallow, lateral border furrow, moderately near the pleuroccipital furrow but more steeply below the eyes. The palpebral lobes are abaxially convex in plan, forming thickened ridges which commence at the axial furrows opposite the outer ends of the first glabellar furrows. They then curve gently outwards and backwards, and finally inwards again so that the posterior ends are longitudinally behind the anterior ends and opposite the mid-points of the second glabellar lobes. The palpebral furrows are only slightly less convex outwards than the rims of the palpebral lobes, narrow, well defined, beginning at the axial furrows and ending by flexing around the hindmost parts of the palpebral lobes and dying out below the visual surface. The visual surfaces of the eyes are schizochroal, decline steeply abaxially, and are slightly convex overall, so that the lower boundary projects beyond the surface of the librigena, with no development of an eye-platform. In one of the largest specimens, the left eye contains approximately ninety-eight lenses arranged in seventeen vertical rows, the number per row varying from three to seven. Most of the lenses are arranged hexagonally, but some are randomly distributed. The facial suture is of proparian type. The anterior branches run forwards from the eyes, almost parallel to the axial furrows, and cut the lateral border immediately outside the anterior ends of the axial furrows. They then turn sharply inwards to meet frontally, running parallel to the frontal glabellar lobe and about one-third of the distance from it to the cephalic margin. The posterior branches curve outwards and slightly forwards for about half their length (*tr.*), and then backwards a little to cut the lateral margins at points in front of the line of the pleuroccipital furrow. Excluding the smooth furrows, most of the cephalic test is covered with closely-set, small granules, but the surface of at least the outer halves of the cheeks is finely pitted (see Pl. 8, fig. 7). The underside of the cephalon is only partly known, but the anterior third has a doublure with a slightly convex, finely granulated, ventral surface and a median length (*sag.*) equal to one-fifth that of the glabella. The lateral parts of the doublure have not been seen and it is not clear whether a vincular furrow is developed.

The hypostoma, excluding anterior wings, is ovoid in plan, three-quarters as broad as long. The anterior margin is broadly rounded in outline with no development of a border, and is continued laterally along the front of the anterior wings, which are triangular in form and deflected dorsally. The maximum breadth of the median body is measured across the bases of the anterior wings, the outline narrowing hence to the semi-elliptical posterior margin. A narrow (*tr.*), brim-like, lateral border is developed from immediately behind the anterior wings, delimited by a narrow border furrow and coalescing with the slightly broader (*sag.*) posterior border. The ventral surface of the median body is only gently convex longitudinally but slightly more so transversely. It is divided into anterior and posterior lobes by a median furrow which is broad (*sag.*) and shallow medially, becoming notably deeper and narrower near the lateral border furrow. The median furrow is strongly arched backwards so that the posterior lobe is crescentic in shape, the ends directed anterolaterally and the maximum breadth (*sag.*) equal to one-fifth of the maximum length of the entire hypostoma.

The entire thorax has not been clearly seen, but the evidence suggests there are at least ten segments and possibly eleven, as in other species of the genus. The axis occupies one-third of the thoracic breadth and stands well above the side-lobes, which decline steeply outwards beyond the fulcra. Each axial ring is transversely straight for about three-quarters of its length (*tr.*) but forms a pair of axial lobes, divergent forwards, at the outer ends. The rings are separated from the articulating half-rings by well-developed articulating furrows. The pleurae are transversely straight for about half their projected length (*tr.*) as far as the fulcra but then become gently curved, at first backwards for a short distance and then forwards to the pleural tips. The latter are well rounded anterolaterally but angular posterolaterally, where there is a small, spinose projection, serving as a stop during enrollment of the thorax (see Pl. 8, figs. 1, 6). Each pleura is divided into two bands by a well-defined pleural furrow, beginning just in front of centre near the axial furrow and running slightly backwards and outwards so that it occupies a medial position at the fulcrum. From there it follows a sigmoidal course, flexing first gently backwards and then forwards, becoming shallower and terminating without reaching the pleural tip. The anterior band of each pleura is turned down anterolaterally to form a large facet.

The pygidium is noticeably smaller than the cephalon, its median projected length being just over half the maximum breadth, the line of which is measured across approximately the mid-point of the pygidium. The outline is subparabolic, ending in a bluntly pointed tip, whilst the frontal margin is broadly rounded in plan. The dorsal surface is strongly convex transversely and steeply declined from front to rear. The axis is straight-sided, its frontal breadth one-third of the maximum breadth of the pygidium, and stands well above the side-lobes. The axial furrows are narrow, sharply incised, particularly frontally, and converge backwards only very slightly for two-thirds the median length of the pygidium. They then die out and the tip of the axis is difficult to define, but it merges into a postaxial ridge which declines posteriorly and extends to the tip of the pygidium (see Pl. 9, fig. 5). There are, in addition to the articulating half-ring, six axial rings separated by transversely straight ring furrows. The first two rings are well defined, but the others become progressively less so, until the fifth and sixth rings are scarcely discernible. The side-lobes are plump, moderately arched laterally, and each has an anterior half-rib, deflected anterolaterally to form a facet, followed by three pleural ribs and a trace of a fourth. Although their inner halves are deeper, the pleural furrows can be traced to the lateral margins. The interpleural furrows also reach the margins but are shallower and narrower (*exsag.*) than the pleural furrows and slightly more convex forwards in plan, dividing each rib into two nearly equal parts, of which the anterior is slightly the larger.

A few immature specimens of *Ormathops borni* were collected. Although fragmentary for the most part, they exhibit certain differences from the presumed adults of the species. Most obviously, the smallest individuals have a conspicuous pair of fixigenal spines, directed posterolaterally and, in the case of the smallest specimen, equal to more than one-third of the median length of the glabella. In addition, the palpebral lobes appear less convex outwards in plan, though of a similar length. The available evidence suggests that the smaller cephala also possessed considerably fewer eye-lenses. One specimen (see Pl. 8, fig. 8) has a pygidial length just over one-third that of the cephalon. Judging from the largest cephala and pygidia found in association it is likely that the relative size of the pygidium increased during ontogeny.

Discussion. *Ormathops* was founded by Delo (1935 : 408) on *Dalmanites atavus* Barrande (1872 : 28) from the Šárka Beds (Llanvirn Series) of Bohemia. A number of varieties, namely *intermedius*, *microphthalmus*, *transiens* and *macrophthalmus*, all of them also from the Šárka Beds, were erected by Novák (*in* Perner 1918 : 39–41) but show only small differences from *Ormathops atavus atavus*. *Ormathops borni* differs from all these in having larger, longer eyes, the visual surfaces of which are directed almost laterally instead of anterolaterally, so that the posterior ends of the palpebral lobes are situated nearer to the sides of the glabella. The first glabellar lobes of *O. borni* are relatively smaller than those of *O. atavus atavus*, and the distance between the outer ends of the first and second glabellar furrows is three-quarters of that between the second furrows and the occipital furrow. In the Czech species these two measurements are about equal. The hypostoma of *O. atavus* (Barrande 1872, pl. 15, fig. 12 ; Struve 1958, fig. 6b), though broadly similar to that of *O. borni* differs from it in having conspicuous lateral indentations behind the anterior wings, whilst the median furrow appears to be developed only laterally. The pygidia of the two species are easily separated, that of *O. atavus* being more triangular in plan, with a longer axis containing eight or so axial rings, and side-lobes made up of five and a half pleural ribs. The corresponding numbers of rings and ribs for *O. borni* are five or five and four and a half respectively.

Whittard (1960 : 128) has redescribed *Ormathops nicholsoni* (Salter) from the Llanvirn Series of the Shelve Inlier and the Lake District. As all his illustrations show distorted specimens comparison with them is difficult, but the facial suture of *O. nicholsoni* is gonatoparian, almost marginal anterolaterally, and it is still not clear whether eyes are present or not. *Ormathops alatus* Whittard (1960 : 131), also from the Llanvirn Series of the Shelve Inlier, has a distinctively short, broad, frontal glabellar lobe, and larger first glabellar lobes than *O. borni*. In addition the fixigenae are much larger than in any other species except *O. nicholsoni*, and the eyes are situated far forwards, opposite the front of the first glabellar lobes, so that the librigenae are very small. Delo (1940 : 12) claimed that *Phacops* (now *Ormathops*) *nicholsoni* is the oldest known species of the Pterygometopinae, but the genus is nowadays assigned to the Dalmanitidae and it is clear that the Family became established earlier than was once thought. There is no record of *Ormathops* prior to the lower Arenig Series, but the genus continued thereafter with little fundamental change and has been found as high as the Llandeilo Series.

REMARKS ON THE CLASSIFICATION OF CALYMENID TRILOBITES

The systematic position of the genus *Neseuretus* [=*Synhomalonotus*] has been debated for a number of years and although the genus has generally been regarded as a calymenid, nevertheless it exhibits a number of homalonotid characters and not long ago the unhappy position was reached whereby the genus (under the name *Synhomalonotus*) was placed simultaneously in two different families in the Treatise on Invertebrate Paleontology (see Moore 1959 : O 453, 456). More recently Kobayashi (1960 : 42) has erected a Family Synhomalonotidae to accommodate trilobites of this type. The confusion concerning *Neseuretus* is, perhaps, symptomatic of the uncertainty surrounding the classification and evolution of the Calymenacea. Trilobites of this superfamily are customarily divided into two Families, Calymenidae and Homalonotidae, each of which is regarded as distinct from the other and divisible into a number of subfamilies.

The Homalonotidae are founded on the Upper Silurian (Ludlow) species *Homalonotus knighti* König, a form which is probably one of the least typical of the trilobites generally attributed to the family, possessing as it does a most unusual, and perhaps specialized, anterior border and rostral plate (see Salter 1863 : 120, pl. 12, fig. 2 ; also Reed 1918 : 275). Thus, although both *Platycoryphe* and *Brongniartella* have both been placed in the Homalonotidae (for example by Whittard 1961 : 163, and by Dean 1961 : 339, 345), it would probably be better to restrict this family to forms resembling the type genus, and to assign these two genera to a more suitable subdivision such as the Eohomalonotinae Hupé 1953, elevated here to Family rank. Although a revision of the Silurian and Devonian genera is still awaited it is likely that many of them at least, for example, *Trimerus*, *Dipleura*, *Burmeisterella*, *Digonus* and *Burmeisteria*, could be accommodated satisfactorily within the Trimerinae Hupé 1953, another subfamily which may well merit Family rank.

Certain Tremadoc genera, for example *Pharostomina* and *Euloma*, have from time to time been put forward as strong contenders for the role of calymenid ancestor or ancestors, but the fact remains that early in the Arenig series the Calymenacea were already established as a number of distinct groups, and whether they be called families or subfamilies is somewhat arbitrary. Subsequently these groups pursued lines of descent through part, or in some cases most, of the Ordovician succession and often showed but little structural modification in the process. In this part of the geological column it is difficult to differentiate reliably between so-called calymenid and homalonotid trilobites, and some groups exhibit a combination of features which have often been regarded as diagnostic of one family or the other. For example, the calymenids *sensu stricto* are characteristically gonatoparian (though exceptionally proparian in at least one species of the genus *Flexicalymene*) with three pairs of well-developed, unequal glabellar lobes, and mostly without a discrete preglabellar field. On the other hand the homalonotids, at least in the Ordovician, typically possess a trapezoidal or subtrapezoidal glabella, sometimes with glabellar furrows, and a scoop-like anterior border. In addition, a pair of paraglabellar areas has been said by Whittington (1965) to be typical of homalonotids. Such structures are certainly lacking in calymenids *sensu stricto*, but they are also strongly developed in *Bathycheilus* whilst the usually described " posteriorly expanded axial furrows " of *Prionocheilus* [=*Pharostoma*] must surely now be interpreted as paraglabellar areas. These last two genera have glabellar outlines and furrows approaching those of the calymenids, accompanied, however, by a distinct preglabellar field and a well-developed opisthoparian facial suture. They stand apart from both calymenids and homalonotids. In classifying the members of the Calymenacea there are a number of courses open. One could continue to use the twofold subdivision already mentioned, but this ignores the number of genera which possess characters of both calymenid and homalonotid type. Alternatively, to " lump " all the genera together as calymenids would certainly be over-simplifying the problem. For the purposes of the present paper it is preferred to utilize a number of families, all of equal rank within the Superfamily Calymenacea. This procedure recognizes that during the early part of the Ordovician a number of cryptogenetic genera appeared and thereafter evolved for varying lengths of time and often in different geographical provinces. It is possible that the Calymenacea may eventually prove to be polyphyletic.

Family **BATHYCHEILIDAE** Přibyl 1953

1953. Pharostomidae Hupé : 232.

Genus ***BATHYCHEILUS*** Holub 1908

Bathycheilus gallicus Dean

(Pl. 10, figs. 4, 8–12)

1965. *Bathycheilus gallicus* Dean : 5, pl. 2, figs. 1–9.

Localities and horizon. *Bathycheilus gallicus* has been found at only two localities, λ2 and λ4, in the Landeyran Valley and is uncommon there. The species is more abundant at the hillside section 250 metres south-west of Le Foulon, where it was found at $\lambda 30$, $\lambda 32$ and $\lambda 33$, especially the last. All these localities are in the Couches du Landeyran inférieures, and *B. gallicus* is also known from presumably the same horizon in the Boutoury district, farther north-east.

Figured material. Guiraud Coll., University of Montpellier (Pl. 10, fig. 4) ; Brit. Mus. (Nat. Hist.) In.57482 (Pl. 10, fig. 8) ; In.57483 (Pl 10, fig. 12) ; It.165 (Pl. 10, fig. 9) ; It.166 (Pl. 10, fig. 10) ; It.167 (Pl. 10, fig. 11).

Description. This characteristic and easily recognized species from the Couches du Landeyran inférieures has already been described and discussed in detail, so that little need be added. Since the original description, a hypostoma of appropriate type has been found in association with fragments of undoubted *B. gallicus* and is assigned tentatively to the species. The hypostoma of *Bathycheilus* has not previously been described, so some doubt as to the identification must remain. The median body is slightly more than one and a half times as long as broad, and is divided into two lobes by a median furrow. The latter is deep and broad (*exsag.*) at its outer ends where it indents the lateral margins of the median body, running backwards and inwards to follow a semi-elliptical path across the median body, and becoming almost obsolete medially. The anterior lobe so formed is ovoid in plan, slightly more convex frontally than posteriorly, and about as broad as long. The posterior lobe of the median body has a maximum breadth little more than twice the maximum length (measured near the outer ends) and is almost reniform in plan, with the posterior margin slightly indented medially. The anterior border, though incompletely preserved, is narrow (*sag.*), brim-like, probably arched forwards moderately, and separated from the median lobe by a broad (*sag.*), shallow furrow. It is confluent laterally with the anterior parts of the anterior wings, the latter forming large, subrectangular processes which have a flattened surface and are obliquely truncated at their outer ends. The hindmost parts of the anterior wings are continued backwards to form the lateral borders, ridge-like in form and sigmoidal in plan so as to form a pair of lateral notches in the hypostomal outline. They curve inwards again posteriorly to join the posterior border, which is slightly lower and broader (*sag.*), though obsolete medially where the posterior margin is cut by a large, curved notch, so that the hypostoma is notably bifurcated. The lateral border furrows are continuous with the anterior border furrow, but markedly narrower (*tr.*) and deeper over their frontal halves. They become shallower opposite the ends of the posterior lobe of the median body but deepen again beyond them, finally shallowing a little as they sweep inwards to join the posterior border furrow.

Discussion. Gigout (1951 : 290, pl. 3, figs. 8–10) noted certain Ordovician trilobites from Morocco as " *Calymene* (*Pharostoma?*) aff. *pulchra* Barrande " and stated that they had earlier been recorded by H. & G. Termier (1950, pl. 189, figs. 19, 21) as both " *Synhomalonotus* sp." and " *Metacalymene? declinata* Barrande ". Gigout claimed that his fragments from Morocco were identical with undescribed specimens, including whole individuals with long genal spines, from Boutoury, Hérault, in Thoral's collection. According to Gigout, although Thoral had compared these specimens to *C. pulchra* they were not, in fact, identical with that species, being much smaller and without a spinose border. I have seen in the University of Montpellier some of the specimens from Boutoury available to Thoral and labelled as " *Pharostoma* ", and it is clear that they are typical examples of *Bathycheilus gallicus*. As I have not had the opportunity of examining Gigout's rather damaged Moroccan material it is not definitely known whether he was dealing with the same species as that from the Montagne Noire, but there is a strong resemblance, as far as can be judged.

Genus ***PRIONOCHEILUS*** Rouault 1847

1847. *Pharostoma* Hawle & Corda : 88.

Certain authors have assumed that *Pharostoma* had priority over *Prionocheilus*, in spite of the fact that the type-material of the type-species *P. verneuili* Rouault 1847 was refigured by Bézier (1907 : 120), who also affirmed that *Prionocheilus* had the earlier date of publication and should therefore be retained. The position has recently been reviewed (Dean 1964) and the prior claim of *Prionocheilus* recognized. The genus has an extended vertical range, occurring as early as the Arenig Series, whilst the last-known representatives are found in the Ashgill Series.

Prionocheilus matutinus sp. nov.

(Pl. 10, figs. 1, 2, 3, 6, 7)

Diagnosis. Species of *Prionocheilus* with glabellar outline well-rounded, broader than long. Three pairs glabellar lobes generally present, those of first pair poorly defined and sometimes obsolete. Second and third pairs of lobes markedly unequal in size, with slight " step " in glabellar outline in front of second lobes. Eyes sited opposite first glabellar furrows and anterior part of anterior glabellar lobes. Ocular ridges poorly developed. Preglabellar field small. Lower surface of librigenae with row of small, ventrally-directed spines.

Holotype. Brit. Mus. (Nat. Hist.) In.57434 (Pl. 10, fig. 7).

Paratypes. In.57428 ; In.57430 (Pl. 10, fig. 3) ; In.57431 ; In.57486 (Pl. 10, fig. 2) ; It.162 (Pl. 10, fig. 1) ; It.164 (Pl. 10, fig. 6).

Locality and horizon. The species has so far been found at only one locality, $\lambda 2$ near the northern end of the Landeyran Valley (see Text-fig. 3). The horizon is in the Couches du Landeyran inférieures.

Description. The cranidium is almost twice as broad as long, moderately convex transversely and longitudinally. The glabella is semi-elliptical in outline, the median length about four-fifths of the basal breadth. There are three pairs of unequal glabellar lobes. The basal lobes are the largest, their length about half that of the glabella, and three-quarters as broad as long. In outline the basal glabellar lobes are of the " cat's ear " plan so well known from many Calymenacea, that is to say rounded posteriorly but angular anterolaterally. The second glabellar lobes are subcircular and slightly less than half the length of the basal lobes. The third glabellar furrows are deep and narrow, and do not quite reach the axial furrows, so that both pairs of glabellar lobes are conjoined abaxially. The third furrows then run slightly backwards adaxially until level with the inner boundary of the anterior glabellar lobes, when they bifurcate. The anterior branches so formed are short, deep at first but shallowing to cross the " necks " linking the second glabellar lobes with the median body of the glabella. The posterior branches are long, curving backwards strongly and ending only a short distance in front of the occipital furrow. The so-called " oval areas " at the inner ends of the third glabellar furrows noted for this genus by Whittington (*in* Moore, 1959 : O 454) are almost unknown in *P. matutinus*, probably owing to the state of preservation. The second glabellar furrows are short (*tr.*), straight at first, directed backwards and inwards, but then turning through a right-angle before ending abruptly opposite the mid-points of the second glabellar lobes. The first glabellar lobes are very small and often almost indiscernible. The axial furrows are gently curved, convex outwards, deep and uniformly narrow over most of their length but constricted slightly opposite the second glabellar lobes and again just behind the line of the outer ends of the third glabellar furrows. From there to the occipital furrow they become united with a pair of paraglabellar areas, longitudinally semi-elliptical in outline, flat-bottomed and set below the dorsal surface of the fixigenae but level with the lower limit of the axial furrows. The curved abaxial margins of the paraglabellar areas are almost vertical and they end posteriorly at the junction of the axial and occipital furrows. The position of the paraglabellar areas coincides with the structures described as " pharostomian scars " in the Estonian species *Prionocheilus* [*Pharostoma*] *nieszkowskii* (Schmidt) by Öpik (1937 : 23 ; see also Hupé 1953 : 72, and Harrington *in* Moore 1959 : O 95–97). The frontal glabellar lobe is broadly rounded, circumscribed by a narrow (*sag.*), well-defined preglabellar furrow which separates it from a small preglabellar field. The last-named narrows (*sag.*) adaxially and is only faintly convex ; it is delimited frontally by an anterior border furrow which is strongest laterally, where it apparently merges with the lateral border furrow, but is much less well developed medially. The anterior border is about half the height of the frontal glabellar lobe, rounded in cross-section and moderately inclined forwards. The lateral border is known only from an incomplete left librigena. It is low, rounded in cross-section, and separated from the inner portion of the cheek by a sharply-incised lateral border furrow. The ventral surface carries a rake-like structure formed by the development of a single row of small spines, directed ventrally and arranged longitudinally (see Pl. 10, fig. 2). Whittington (*in* Moore 1959 : text-fig. 357), in a reconstruction of the genus, shows similar spines extending only along the ventral side of the librigenae, but specimens of *Prionocheilus* from Bohemia, in the British Museum (Natural History), as well as others figured by Whittard (1960, pl. 18, figs. 2–4, 6) from West Shropshire show clearly the continuation of the row across the ventral surface of the rostral plate. The occipital ring is transversely straight and parallelsided for the most part, with a trace of a small median tubercle, but abaxially it narrows owing to indentation by the posterior margins of the third glabellar lobes, and forms a pair of occipital lobes, directed anterolaterally towards the posterior ends of the paraglabellar areas. The occipital furrow is narrow (*sag.*) and deep, transversely straight over its median third but then curves around the third glabellar lobes. The pleuroccipital furrow meets the axial furrows well behind the line of the median third of the occipital furrow. It is fairly narrow (*exsag.*) and almost straight- as far as the fulcra, where it becomes progressively broader and curves backwards gently to meet the lateral border furrows. Correspondingly the pleuroccipital segment is almost uniformly narrow (*exsag.*) as far as the fulcra but then increases gradually in breadth as it curves gently backwards and outwards ; its outer ends are not known. The genal angles and, presumably, librigenal spines are not known. The palpebral lobes are small, situated opposite the second glabellar lobes. They decline gently inwards and are scarcely differentiated from the fixigenae. From the palpebral lobes the anterior branches of the facial suture run forwards, gently convergent and subparallel to the axial furrows, to cut the anterior border approximately in-line longitudinally with the outer margins of the paraglabellar areas before running slightly below the top of the anterior border to meet frontally. The rostral plate is not preserved. The posterior portions of the fixigenae are moderately declined laterally, and the posterior branches of the facial suture are strongly arched backwards, though their outer ends have not been found preserved. Although the palpebral lobes are sited at the apices of the fixigenae, there is no development of eye-ridges such as occur sometimes in other species of *Prionocheilus*. The surface of most of the test, excluding furrows, is ornamented with closely-grouped tubercles, both small and of medium size, the larger ones often showing traces of a median perforation. The lateral border is finely granulated, whilst the preglabellar field carries only a few, more widely distributed, larger tubercles.

The hypostoma is not known.

The thorax is fragmentary and poorly preserved but appears to be typical for the genus. There are thirteen thoracic segments and one specimen shows the surface of the test, excluding the furrows, to be covered with granules similar to those on the pygidium.

The pygidium is represented by a single, small specimen (see Pl. 10, fig. 3). When held with the pygidial axis horizontal the median length of the pygidium, excluding the articulating half-ring, equals two-thirds of the maximum breadth, and the frontal margin is strongly arched forwards. The posterolateral margins are slightly convex and gently rounded, their curvature in-line with the broadly-rounded tip of the pygidium. Frontally the axis occupies one-third of the total pygidial breadth. It tapers only slightly for two-thirds of its length but then more sharply to the bluntly-pointed tip, which does not reach the posterior margin. The axial furrows are broad and deep frontally, becoming narrower posteriorly and circumscribing the axial tip. There is no postaxial ridge. Excluding the articulating half-ring there are five axial rings, the fifth less well defined than the others, followed by a large, subtriangular terminal piece. The side-lobes carry, in addition to the anterior pair of half-ribs, four more or less well-defined pairs of pleural ribs, with traces of a fifth pair. The ribs are separated by deep, narrow pleural furrows which arch backwards strongly, and the first three pairs of ribs carry interpleural furrows which are best developed immediately outside the axial furrows. The surface of all the pygidium, apart from the various furrows, is conspicuously granulated.

DISCUSSION. *Prionocheilus* has an extremely long vertical range and is known throughout most of the Ordovician, from the Arenig to the Ashgill Series. The numerous species described have been noted (as *Pharostoma*) by Whittard (1960 : 137) and the points of difference assessed.

Prionocheilus pulcher (Beyrich) is reputed to extend from the Llanvirn to the Caradoc Series in Bohemia, but in South Wales and the Shelve Inlier it is known only from the Lower Llanvirn. The species, which appears to be larger than *P. matutinus*, has a slightly broader glabella with more clearly defined first glabellar lobes, a longer (*sag.*) preglabellar field, and eyes which are sited a little farther forwards, at the outer ends of distinct ocular ridges. The pygidium of *P. matutinus* is arched forwards more strongly in plan than that of *P. pulcher*, and the side-lobes have only four pairs of pleural furrows compared with six in the Bohemian species. The axial furrows of *P. pulcher* converge backwards to the third ring furrow and then run parallel, whereas in *P. matutinus* the axis narrows gently and uniformly backwards to the bluntly-pointed terminal piece. There are five axial rings in *P. matutinus* and six in *P. pulcher*. The Bohemian subspecies from the Šárka Beds (Llanvirn Series), separated by Šnajdr (1956 : 29) as *Pharostoma pulchrum vokovicense* can be easily distinguished by its well-developed preglabellar field, the anterior half of which is flat and smooth whilst the posterior half forms a transverse ridge ornamented with granules like those on the remainder of the cephalic test.

Prionocheilus verneuili Rouault (1847, pl. 3, fig. 3) from Brittany has been refigured by Bézier (1907). Some of the differences between this species and *P. pulcher* have been noted by Whittard (1960 : 137), but Rouault's type-material at Rennes University shows clearly that the eyes of *P. verneuili* are opposite the second glabellar lobes, that is, in a position similar to those of *P. pulcher*. The anterior border of *P. verneuili* is a little longer than in the Czech species and less distinct from the preglabellar field, though the anterior border furrow may have been obscured by crushing. A feature which is not made clear by Bézier's photographs, owing to the angle at which the specimen was illuminated, is the manner in which the front of each third glabellar lobe is partly fused with the back of the adjacent second lobe, the second glabellar furrows being reduced to shallow depressions. I have seen a similar development of the second glabellar furrows in stratigraphically younger specimens of *Prionocheilus* from Czechoslovakia, but they are deeper in specimens from the Llanvirn Series of both Britain (Whittard, 1960 : 135) and Bohemia (see *P. pulcher vokovicensis* Šnajdr ssp., 1956 : 29). The third glabellar lobes of *P. verneuili* are slightly longer than those of *P. pulcher* and, as far as can be judged, the paraglabellar areas of the Breton form are larger and broader than those in other species. When illustrating Rouault's species, Bézier utilized not only the type-material from Poligné but also better-preserved specimens from the well-known locality of Le Traveusot, and it is not clear whether the horizons or species are identical. A crushed pygidium in Rouault's collection from Poligné indicates seven axial rings and six rib furrows, apparently more than are shown in Bézier's specimens from Traveuzot. *Prionocheilus matutinus*, probably a smaller form than *P. verneuili*, has a narrower glabella, shorter anterior border, and a much less well-developed preglabellar field. The eyes occupy a similar position in the new species but lack strong ocular ridges, whilst the paraglabellar areas are smaller. The pygidium of *P. matutinus* has fewer axial rings and pleural furrows than that of *P. verneuili.*

Immature cranidia of *Prionocheilus matutinus* bear some resemblance to the genus *Colpocoryphoides* Harrington & Leanza (1957 : 222–224), founded on *Pilekia trapezoidalis* Harrington (1938 : 191, pl. 6, fig. 22) from the Upper Tremadoc and Lower Arenig of Argentina. The glabella of *C. trapezoidalis* is more truncated frontally, however, and has three well-defined pairs of glabellar lobes, but the anterior border and small preglabellar field are reminiscent of those in *P. matutinus* whilst certain of Harrington & Leanza's illustrations show a slight posterior widening of the axial furrows, suggesting the possibility of paraglabellar areas. Whittington (*in* Moore 1959 : O 453) placed *Colpocoryphoides* in the synonymy of *Pharostomina* Sdzuy (1955 : 31), from the Leimitz-Schiefer (Tremadoc Series), an assertion accepted by Harrington & Leanza in an addendum to their 1957 paper. Certain of the illustrations of the type-species *Pharostomina oepiki* Sdzuy (1955, pl. 6, figs. 62–75) exhibit what appear to be moderately developed paraglabellar areas.

Family **COLPOCORYPHIDAE** Hupé 1955

Genus ***COLPOCORYPHE*** Novák *in* Perner 1918

Vanêk (1965) placed *Colpocoryphe* in the synonymy of *Plaesiacomia* Hawle & Corda 1847. I prefer to maintain the two as separate genera, and propose to discuss the problem in detail at a later date.

Colpocoryphe thorali sp. nov.

(Pl. 10, fig. 5 ; Pl. 11, figs. 1–10 ; Pl. 12, figs. 1–11)

Diagnosis. Species of *Colpocoryphe* with bell-shaped glabellar outline and three pairs unequal glabellar lobes, first pair smallest and poorly defined. Breadth of frontal glabellar lobe two to three times median length. Anterior border short (*sag.*) medially, expanding anteroventrally in front of axial furrows. Eyes almost pedunculate, close to glabella, opposite first pair and front half second pair glabellar lobes. Librigenae large, convex. Hypostoma bifid, with lateral margins indented behind anterior wings ; median body divided into two unequal lobes. Thorax of thirteen segments. Pygidium convex, subtriangular, with six or seven axial rings on internal mould ; fewer rings show on external mould. Side-lobes with one or two pairs pleural furrows and pair of deep marginal furrows forming vincular attachment with margins of librigenae.

Holotype. Brit. Mus. (Nat. Hist.) In.56654 (Pl. 12, figs. 2, 6, 9).

Paratypes. In.57438 (Pl. 12, fig. 3) ; In.57552 (Pl. 12, fig. 1) ; In.57586 (Pl. 11, fig. 6) ; In.57622 (Pl. 11, fig. 1).

Other figured material. In.57498 (Pl. 11, fig. 7) ; In.57502 (Pl. 12, fig. 10) ; In.57504 (Pl. 11, fig. 9) ; In.57510 (Pl. 11, fig. 5) ; In.57516 (Pl. 12, fig. 11) ; In.57594 (Pl. 12, fig. 4) ; It.168 (Pl. 10, fig. 5) ; It.170 (Pl. 11, figs. 2, 10) ; It.171 (Pl. 11, figs. 3, 8) ; It.172 (Pl. 11, fig. 4) ; It.173 (Pl. 12, figs. 5, 8) ; It.174 (Pl. 12, fig. 7).

Localities and horizons. The holotype and two of the paratypes were collected from locality $\lambda 16$, south-east of the road in the southern part of the Landeyran Valley, whilst the remaining paratypes are from the nearby $\lambda 20$. Both localities are in the Couches du Landeyran supérieures, strata in which *Colpocoryphe thorali* is abundant and almost ubiquitous, so that it is not proposed to list the numerous places at which it occurs. The species occurs also in the Couches du Landeyran inférieures, but in notably smaller numbers. It was found in the northern part of the Landeyran Valley at $\lambda 2$ and $\lambda 4$, as well as at localities $\lambda 30$ to $\lambda 33$, especially $\lambda 32$, in the hillside section 240 metres south-west of Le Foulon. Uncommon fragments of *Colpocoryphe* from the Couches du Foulon, though too poorly preserved for certain identification, are generally similar to the new species.

Description. The entire dorsal exoskeleton is longer than broad approximately in the ratio 8 : 5, the maximum breadth being measured across the cephalon at the line of the pleuroccipital furrow. The cephalon is semicircular in plan with the dorsal surface moderately declined forwards and strongly convex transversely. The glabella is plump, standing well above the fixigenae, and bell-shaped in plan with projected length and breadth approximately equal. It is bounded by axial furrows which are deep and narrow, subparallel over their anterior halves but divergent posteriorly at 45–50° from just behind the second glabellar furrows. Three pairs of unequal glabellar lobes increase in size from the first to third lobes. The third glabellar lobes are the largest, about one-third of the projected length of the glabella and generally subcircular in plan but angular anterolaterally. The lobes are joined to the median body of the glabella by broad (*exsag.*) " necks " which equal half their own length (*exsag.*) and have a convexity continuous with that of the third lobes. The posterior margins of the third lobes are slightly convex backwards, indenting the occipital furrow and ring. The third glabellar furrows are broad (*exsag.*) and uniformly deep, arching inwards and backwards from the axial furrows to end opposite the centre of the third lobes. In certain internal moulds of crushed specimens the third furrows appear straighter than has been described. The second glabellar lobes are subrectangular, their long axes broadly divergent forwards and their tips level with the centres of the third lobes. The second glabellar furrows are sited a little in front of centre of the glabella and are deepest at the axial furrows, becoming shallower as they curve adaxially and slightly backwards to end in-line with the third furrows. The second furrows show clearly on internal moulds, but on external moulds they often appear as little more than notches in the glabellar outline. The first glabellar lobes are almost as long (*exsag.*) as the second lobes but appear smaller on account of the poorly-defined first glabellar furrows which form narrow (*exsag.*), almost straight incisions extending only a little way from the axial furrows. The frontal glabellar lobe is subrectangular in plan, rounded anterolaterally, and generally with an almost straight anterior margin, though some specimens have a shallow (*sag.*) concavity which gives the suggestion of a pair of anterolateral lobes. A similar feature has been noted on certain specimens of *Neseuretus* (see p. 311). There seems to be a small amount of variation in the length of the frontal glabellar lobe, ranging from almost half to one-third of its maximum breadth, and the lateral margins of the shorter examples are slightly more convergent forwards than those of the longest. However, it has not been established that such extremes represent more than normal variation within the species, as they occur in specimens which are otherwise identical, and have been found both separately and in association throughout a large thickness of strata. Immediately in front of the frontal glabellar lobe, and separated from it by only a shallow groove, is a smooth, slightly convex border which declines forwards almost vertically to the cephalic margin. In anterior view the frontal margin of the cranidium is strongly arched transversely, giving the impression of being bifid with a large median indentation, owing to the development of a pair of rounded projections directed forwards and almost vertically downwards in front of, and adjacent to, the axial furrows (see Pl. 11, fig. 2 ; Pl. 12, fig. 5). The function of these structures is discussed later. The median two-thirds of the occipital ring are parallel-sided, their length (*sag.*) one-fifth that of the glabella ; abaxially the ring becomes shorter and curves forwards slightly to form a pair of occipital lobes which end level with the third glabella lobes. The occipital furrow is fairly shallow medially but deepens laterally to a pair of apodemes. The pleuroccipital segment is narrow (*exsag.*) immediately outside the axial furrows, but expands uniformly to twice this breadth just beyond the fulcra before narrowing more sharply at the rounded genal angles. The pleuroccipital furrow is transversely straight, broad (*exsag.*) and moderately deep for the most part, but becomes shallower abaxially where it turns forwards and is continuous with the lateral border furrow. The latter is developed posteriorly as a broad, shallow groove which quickly becomes obsolete. The eyes are almost pedunculate, situated well forwards opposite the first pair and the anterior half of the second pair of glabellar lobes, and only a short distance from the axial furrows. The palpebral lobes are abaxially convex without palpebral furrows ; they stand almost as high as the glabella and decline steeply towards the axial furrows. Some specimens show traces of a pair of ocular ridges, but these parts of the test are generally obscured by crushing. The visual surfaces of the eyes are holochroal and in lateral view are seen to decline forwards slightly. No estimate of the number of eye lenses present has yet proved possible. The eyes are separated from the librigenae by broad, rounded furrows but no definite eye-platform is developed. The anterior branches of the facial suture run forwards from the eyes, diverging very slightly from the axial furrows until beyond the front of the glabella, where they flex inwards to circumscribe the bifid anterior projections of the cranidium which were described earlier, and finally curve backwards to meet at the apex of the median indentation of the anterior border. The posterior branches of the facial suture arch uniformly outwards and back from the eyes to cut the genal angles, delimiting large fixigenae which have their outer two-thirds turned-down abaxially. The librigenae are steeply declined and in certain less distorted specimens their plump dorsal surfaces project as far as, or even beyond, the lateral margins. They are approximately triangular in outline with curved boundaries, the lateral margin convex, the other sides slightly concave. The anterolateral angles are produced to form a pair of hook-like extensions which curve inwards and back ; they were originally linked by a narrow strip of the test, but this part of the exoskeleton is almost invariably obscured by crushing. The surface of the glabella, occipital ring, cheeks and pleuroccipital segment is covered with small, closely-set granules but it is not clear whether such ornamentation extended over the anterior border.

The hypostoma, excluding anterior wings, is about two-thirds as broad as long, its ventral surface only moderately convex. The frontal margin is broadly arched forwards, continuous with that of the anterior wings which are long (*tr.*), subtriangular in plan, and deflected dorsally, particularly over their outer halves. Immediately behind the anterior wings the hypostomal outline narrows slightly but then expands to attain its maximum breadth a little behind centre. Beyond this point the outline narrows more sharply to the bifid posterior margin. There, the posterior wings are triangular, separated by a narrow median notch whose length (*sag.*) is almost one-sixth that of the entire hypostoma. The median body is divided into two lobes by a median furrow which is semi-elliptical, concave forwards and shallow medially, becoming deeper and narrower (*exsag.*) abaxially. The anterior lobe is ovoid in outline, its frontal margin bounded by a broad (*sag.*), poorly defined anterior border which narrows medially and fuses abaxially with the anterior wings. The swollen posterior lobe is crescentic in plan and its maximum breadth (*tr.*) exceeds that of the anterior lobe in the ratio 5 : 4. The median body is bounded laterally by a deep, narrow border furrow which shallows a little posteriorly. The lateral border is narrow and ridge-like immediately behind the anterior wings, with which it coalesces, but becomes broader posterolaterally and is continuous with the posterior wings.

The thorax consists of thirteen segments. The axis is broad, occupying almost half the projected thoracic breadth, and is bounded by deep, broad axial furrows. The axial rings are about six times as broad as long (*exsag.*), flexing slightly backwards and then forwards abaxially to end in a pair of weak axial lobes. Each has a well-developed articulating half-ring and furrow. The pleurae are horizontal for about half their length (*tr.*) but turn down through almost a right-angle. They are transversely straight as far as the fulcra, but then curve slightly backwards and forwards again, their anterolateral margins being deflected ventrally to form articulating facets. Each pleura carries a narrow (*exsag.*) pleural furrow which appears broader on the internal mould and runs from the anterior margin at the axial furrow. The pleural furrow is directed slightly backwards abaxially until beyond the fulcrum, where it curves forwards slightly and dies out without attaining the pleural tip, which is rounded for the most part but subangular anterolaterally.

The pygidium is transversely convex, steeply declined posteriorly when uncrushed, and quadrant-shaped in plan with well-rounded anterior margin. The lateral margins meet at a blunt point and are generally straight, though some material shows them slightly concave posteriorly. The axis stands conspicuously higher than the side-lobes and is bounded by axial furrows which appear deep and broad on the internal mould but are less conspicuous on the external mould. Similarly, the axial rings are better defined in the case of internal moulds, and the number of rings present is six, with traces of a seventh, in one of the largest specimens so preserved, though only two are clearly visible on the corresponding external mould. The axis narrows more strongly posteriorly but continues almost to the tip of the pygidium and forms a conspicuous terminal piece. The side-lobes are arched downwards abaxially and each generally shows only traces of one or two pleural furrows. Their most conspicuous feature, however, is a pair of deep, broad furrows which run parallel to the lateral margins and continue posteriorly, becoming slightly concave in plan abaxially, so as to indent the lower part of the hindmost third of the axis, giving it an undercut appearance. These furrows are a characteristic feature of *Colpocoryphe* and it is now clear that they are vincular structures. During enrollment of the exoskeleton the terminal piece of the pygidial axis engaged with the median indentation of the front of the cephalon. At the same time the margins of the librigenae overlapped the ridge-like pygidial margins and came to rest in the marginal furrows and against the undercut posterior part of the axis. The result must have been an extremely efficient form of fastening. It is interesting that a superficially similar pair of anterior cephalic projections was illustrated by Brøgger (1882, pl. 5, figs. 1, 2) for *Cheirurus clavifrons* Dalman, a species now assigned to *Cyrtometopus*. These structures may also have functioned during enrollment but differ fundamentally from those of *Colpocoryphe* by being developed from the rostral plate. The surface of at least the lateral portions of the pygidium of *C. thorali* is ornamented with small granules like those of the cephalon.

Several immature specimens of *Colpocoryphe thorali* were collected, most of them in a fragmentary condition and all either meraspides or small holaspides. They were found at a variety of localities and horizons, but λ19, in the Couches du Landeyran supérieures near the southern end of the Landeyran Valley, proved particularly fruitful. The smallest specimen, not figured here, is a very small Meraspis from the Couches du Landeyran inférieures at locality λ2. It is a cranidium, In. 57433, preserved as an internal mould, with a basal breadth of 0·8 mm. and a median length of approximately 0·5 mm. The glabella is subcylindrical and conspicuously narrow, about 0·125 mm. The eyes are sited close to the glabella almost at its anterior end, and the occipital ring is small and short with traces of a pair of apodemes in the outer ends of the occipital furrow. Slightly larger cranidia about 1 mm. broad (see Pl. 11, figs. 5, 7) show a generally similar form but the glabella is more depressed and relatively broader, almost one-quarter of the total breadth. Even in the later stages of the Meraspis the glabellar outline is still subrectangular (for example Pl. 11, fig. 9), but the palpebral lobes occupy a position corresponding to that in the adult, although they appear to be slightly larger. In specimens of Meraspis Degree 11 (Pl. 11, fig. 9) the glabellar lobes are visible, though indistinct, but become progressively better defined later, the posterior part of the glabella expanding laterally at the same time.

DISCUSSION. The type species of *Colpocoryphe* was described as *Calymene arago* (a name frequently misquoted as *aragoi*) by Rouault (1849 : 88, pl. 2, fig. 3). Unfortunately his material, which came from cleaved dark mudstones at La Couyère, Brittany, comprised specimens which had been more or less distorted, and the species still awaits redescription in modern terms. *Colpocoryphe arago* was figured from a number of horizons and localities other than the type by several authors including de Verneuil & Barrande (1855 : 973), using Spanish material, and later by Barrande (1872 : 34) from Bohemia though his specimens are now referable to *Colpocoryphe bohemica* Vaněk sp. (1965 : 26). Descriptions such as these seem to have formed the basis of all subsequent interpretations of *C. arago*, and this must be borne in mind when comparing the species with others. Judging from Breton specimens preserved uncrushed in siliceous nodules, *Colpocoryphe arago* is a notably larger species than *C. thorali*, generally with a slightly shorter, broader glabella and eyes which are smaller, shorter and set slightly lower in relation to the glabella. The pygidia of the two species are broadly similar but that of *C. arago* has a narrower, more convex axis and the inner parts of the side-lobes are slightly larger. The terminal piece of the Breton species appears to be thicker and more conspicuous, but this part of the exoskeleton is difficult to compare owing to crushing in the material from the Montagne Noire.

Colpocoryphe salteri (Rouault 1851 : 358) from the Ordovician of Brittany has a broader, more convergent glabellar outline than either *C. arago* or *C. thorali*, and the eyes appear to be placed even farther forwards, opposite the first glabellar lobes. The pygidium of this species is distinctive, conspicuously large, with a narrow axis and plump side-lobes which carry traces of numerous pleural furrows and have the vincular furrows only lightly impressed midway between the axial furrows and the lateral margins. Thadeu (1949) has recorded this species, as *Synhomalonotus salteri*, from the Bussaco and Valongo districts of Portugal, but after an examination of Rouault's type material at Rennes University I agree with Pillet (*in* Cavet & Pillet 1964 : 324) that it belongs with *Colpocoryphe*, as does *Synhomalonotus lusitanica* Delgado MS., also from Valongo (Thadeu 1949 : 7).

The holotype of *Calymene* (*Colpocoryphe*) *grandis* Šnajdr (1956 : 25) is a cranidium about twice the size of the largest available specimens of *C. thorali*, from which it differs in having a more trapezoidal glabellar outline, deeper glabellar furrows and eyes set slightly farther back. One of the paratypes of *Colpocoryphe grandis* is a large cephalon in which the glabellar outline broadens slightly behind the second glabellar lobes, as in *C. thorali*, but the frontal glabellar lobe expands anterolaterally to form a fairly distinct pair of lobe-like projections. There are also traces of a fourth pair of glabellar lobes. *C. grandis* occurs in the Drabov and Letná Beds of Bohemia and is therefore stratigraphically much later than *C. thorali*. Another Bohemian species *Colpocoryphe inopinata* (Novák *in* Perner, 1918 : 10, 36) from the Šárka Beds (Llanvirn Series) is easily distinguished by its strongly convergent, almost subtriangular, glabellar outline and the unusually anterior position of the eyes, opposite the frontal half of the frontal glabellar lobe.

Gigout's record (1951 : 280) of *Colpocoryphe arago*, associated with *Plesiomegalaspis* *graffi* Thoral (described from the Arenig Series of the Montagne Noire) suggests that *C. thorali* might occur in certain North African faunas.

Family **SYNHOMALONOTIDAE** Kobayashi 1960

Genus ***NESEURETUS*** Hicks 1872

1898. *Synhomalonotus* Pompeckj : 240.

Neseuretus ramseyensis Hicks 1872 was designated as type species of the genus by Vogdes (1925 : 106), but Whittard (1960 : 139) has shown this specific name to be a junior subjective synonym of *Neseuretus murchisoni* (Salter 1865). Hicks's genus remained either overlooked or misunderstood for many years until redescribed by Whittard (1960 : 138), who demonstrated that *Neseuretus* is a subjective synonym of, and has priority over, *Synhomalonotus* Pompeckj 1898. Nevertheless the familial name Neseuretidae cannot be used while Article 40 of the International Code of Zoological Nomenclature remains in force. The type-specimens of *Calymene tristani* Brongniart (1822 : 12), the type-species of *Synhomalonotus*, were refigured by Pompeckj (1903). They came from the so-called " Schistes à Calymènes " in their characteristic development in the Contentin Peninsula, at the western end of Normandy, and Pompeckj's illustrations confirm Whittard's assertion of the identity of the two genera. Although Brongniart's species has been reported from the Ordovician rocks of the Landeyran Valley on a number of occasions it has not been confirmed, and the genus is represented there by at least two new species.

Neseuretus antetristani sp. nov.

(Pl. 13, figs. 1–9)

Diagnosis. Large species of *Neseuretus* with trapezoidal glabellar outline, the straight sides moderately convergent forwards. Three pairs glabellar furrows present but only weakly developed, especially on external moulds. Large paraglabellar areas poorly defined. Eyes small, opposite first glabellar lobes. Ocular ridges strongly developed, slightly convex forwards. Anterior area large, inclined forwards, its posterior half slightly convex and posterior half slightly concave dorsally. Outer parts of anterior area indented anterolaterally by pair large notches, possibly ends of anterior border furrow. Rostral suture in supramarginal position. Large pygidium has nine or ten axial rings and about seven pairs ribs.

Holotype. Brit. Mus. (Nat. Hist.) In.57475 (Pl. 13, figs. 3–5).

Paratypes. In.56682 (Pl. 13, fig. 8) ; In.56857 ; In.57473 (Pl. 13, figs. 2, 6, 7) ; In.57474 (Pl. 13, fig. 9) ; In.57476 ; In.57478 (Pl. 13, fig. 1) ; It.274.

Localities and horizon. All the known specimens are from the south-eastern side of the Landeyran Valley where the species occurs only in the Couches du Landeyran supérieures. The holotype is from $\lambda 17$, and other localities are $\lambda 16$ and $\lambda 20$.

Description. The cranidium is subtriangular in plan, one and a half times as broad as long, and strongly convex both longitudinally and transversely, with its dorsal surface steeply declined frontally. The glabella is convex, as broad as long, generally trapezoidal in outline, and narrows forwards noticeably so that the frontal breadth is half the basal breadth. The sides of the glabella are almost straight or gently convex outwards. One specimen (Pl. 13, fig. 9), preserved as an internal mould, shows a slight median carination of the glabella, which may be due to crushing. There are three pairs of glabellar lobes, declining in size from back to front of the glabella and separated by shallow glabellar furrows which are discernible in their entirety only on the internal mould. The centre of the glabella is occupied by a smooth median band, one-third of the glabellar breadth. The third glabellar lobes are the largest and expand in size laterally so that at the axial furrows they occupy two-fifths of the length of the glabella. The third glabellar furrows are broad (*exsag.*) and shallow at their intersection with the axial furrows, but arch thence backwards and inwards, finally stopping short of the occipital furrow so as to leave a pair of unfurrowed " necks " whose breadth (*exsag.*) is about one-third the length (*exsag.*) of the third lobes, as far as can be judged. The second glabellar lobes are just over half the size of the third lobes and poorly defined, even on the internal mould. The second glabellar furrows are slightly curved, convex forwards, shallow and broad (*exsag.*) at the axial furrows but dying out rapidly, apparently so as to end in-line with the third furrows. The first glabellar lobes are almost indiscernible and smaller than the second lobes. Like the other pairs of glabellar lobes, their convexity is continuous with that of the remainder of the glabella, and they are delimited by very faint first glabellar furrows ; a single internal mould shows the left first furrow (the only one preserved) in what Whittard (1960 : 143) described as a " perched " position on the glabella, and not reaching the axial furrow. The frontal glabellar lobe is approximately rectangular in plan, and about three times as broad as long (*sag.*). In detail its outline is rather more complex, the anterior margin having a broad (*tr.*) median indentation, and the anterolateral portions of the lobe expanding a little. In juxtaposition with each of these last features there occurs a large, almost square depression, in the concave floor of which is a suggestion of a hypostomal pit, situated immediately outside the anterolateral margin of the frontal glabellar lobe (see Pl. 13, figs. 3, 4). The axial furrows are narrow grooves situated at the bottom of large, broad furrows which are V-shaped in cross-section, with the adaxial side the more steeply declined. They are continuous forwards as far as the first glabellar furrows, at which point they are indented by the adaxial ends of a pair of large ocular ridges, which cause them to be deflected inwards for a short distance before turning outwards again to reach the pair of anterolateral depressions already mentioned as possibly containing the hypostomal pits. The depressions mark the outer ends of a broad (*sag.*) preglabellar furrow which flexes backwards medially, coincident with the indentation of the frontal glabellar lobe, and is slightly deeper abaxially. The portion of the cranidium between this furrow and the cephalic margin, and bounded posterolaterally by the " anterior furrows ", has been called the " anterior area " by Whittard (1960 : 143), who suggested that it probably represented the combined anterior border and preglabellar field. In this instance the posterior half of the anterior area is slightly convex dorsally, whilst the anterior half is gently concave, the whole being strongly arched transversely (see Pl. 13, fig. 4). A curious feature of the species is the presence of a pair of large, deep notches (see Pl. 13, figs. 4, 5) which indent only the abaxial parts of the anterior area well forwards and may represent the outer ends of a now semi-obsolete anterior border furrow. The holotype cranidium retains the rostral plate *in situ* and this specimen shows that the rostral suture occupies a supramarginal position frontally (see Pl. 13, figs. 3, 5). The anterior branches of the suture run in straight lines from the eyes, converging forwards until they cut the anterior furrows and the deep notches (? anterior border furrow) just described. They then turn sharply inwards to meet frontally and form a rostral suture which runs close to the cephalic margin at the sagittal line but always remains slightly above it (Pl. 13, fig. 5). The rostral plate has the anterior and posterior margins parallel and arched forwards, and the ventral surface is convex. The connective sutures are not preserved, and the hypostoma is not known. The occipital ring is large, its maximum length (*sag.*) about a quarter that of the glabella. Parallel-sided over almost the median two-thirds, the occipital ring becomes shorter abaxially and flexes forwards slightly to form a pair of well-developed occipital lobes. The occipital furrow is shallow for most of its length (*tr.*) but deepens near the axial furrows, though it is not clear whether apodemes are present. The pleuroccipital furrow is deep, broad, well defined, subquadrate in cross-section, and almost straight transversely. The single outer end of this furrow preserved on the holotype suggests a slight curvature backwards, but this is probably due to crushing and one of the paratypes (Pl. 13, fig. 8) shows the pleuroccipital furrow curving forwards abaxially. The pleuroccipital segment is narrow (*exsag.*) immediately outside the axial furrows but quickly widens, particularly beyond the fulcra. The palpebral lobes are small, situated relatively far forwards, opposite the first glabellar lobes. They mark the outer ends of a pair of strongly-developed ocular ridges which curve outwards and slightly backwards from the axial furrows opposite the posterior half of the frontal glabellar lobe. The anterior portions of the fixigenae are small and decline steeply forwards, whilst the posterior portions are conspicuously large with their outer halves turned down sharply. The holotype exhibits a pair of large, quadrant-shaped paraglabellar areas, faintly defined by furrows which meet the axial furrows slightly behind the line of the third glabellar furrows and then curve outwards and backwards towards the pleuroccipital furrow. The posterior branches of the facial suture curve evenly and strongly back from the eyes to meet the genal angles.

The thorax, though incompletely known, comprises thirteen segments and is of the type characteristic for the genus. The axis is well defined by broad axial furrows and stands higher than the side-lobes. Each axial ring is transversely straight over its median half but turns forwards abaxially to form a pair of large axial lobes. The pleurae are parallelsided and transversely straight as far as the fulcra, beyond which they curve forwards and end in tips which are broadly rounded for the most part but angular posterolaterally. Each pleura carries a pleural furrow which commences at the anterior margin immediately outside the axial furrow. At first the furrow is deep and narrow (*exsag.*), runs outwards and only slightly backwards until beyond the fulcrum, when it curves forwards gently, becomes broader and dies out towards the pleural tip. The anterolateral part of each pleura is slightly depressed so as to form a large articulating facet.

The pygidium is strongly convex, its axis declined backwards steeply and the side-lobes curved and sharply downturned laterally. The axis stands higher than the side-lobes and its straight sides converge backwards at about 30°. The largest pygidium has nine well-defined axial rings and a trace of a tenth, in addition to the articulating half-ring. The first two axial rings flex forwards near the axial furrows but the remainder are transversely straight, separated by uniformly and moderately deep ring furrows. The axial tip is small but distinct, followed by a rounded post-axial ridge extending to the tip of the pygidium. Each side-lobe has an anterior half-rib and, in the best-preserved specimen, seven well-defined ribs which curve backwards more strongly from first to seventh until the hindmost are only slightly divergent posteriorly. The pleural furrows separating the ribs run from the axial furrows and become shallower abaxially, but they can be traced to the pygidial margin. Each rib carries an interpleural furrow which is developed over its abaxial half and becomes fainter near the margin. A small pygidium from the type-locality has only seven axial rings and four or five ribs, but is believed to belong to the same species.

All the type-material is preserved as limonitic internal and external moulds and little remains of the surface ornamentation. Part of the right fixigena of the holotype exhibits evenly-distributed fine granulation, and similar ornamentation occurs on the surface of one paratype pygidium.

Discussion. For convenience the species of *Neseuretus* are discussed together after the description of *N. arenosus* sp. nov.

Neseuretus arenosus sp. nov.

(Pl. 14, figs. 1, 4, 5, 7–9, 11)

Diagnosis. Species of *Neseuretus* with short (*sag.*), broad glabella and three pairs glabellar lobes, those of first pair poorly defined. Frontal glabellar lobe broad (*tr.*) with anterior margin slightly concave medially. Anterior area relatively short (*sag.*), moderately declined forwards, its dorsal surface uniformly and gently convex and unfurrowed. Eyes opposite first pair and most of second pair glabellar lobes. Frontal parts of fixigenae broad. Pygidium with six axial rings, and five or six pleural ribs plus anterior half-ribs.

Holotype. Brit. Mus. (Nat. Hist.) In.57754 (Pl. 14, figs. 7, 9, 11).

Paratypes. In.57453 ; In.57751 (Pl. 14, figs. 1, 4, 8) ; In.57752 (Pl. 14, fig. 5).

Localities and horizons. The holotype and two of the paratypes are from the Couches du Foulon at locality $\lambda 7$, on the north-western side of the Landeyran Valley almost 500 metres south-west of Upper Bridge. The remaining paratype was found in a loose nodule weathered from, presumably, the Couches du Landeyran inférieures at a point about 400 metres north-east of l'Escougoussou.

Description. The exoskeleton is known only from isolated cranidia and pygidia. The cranidium is moderately convex, both transversely and longitudinally, with a projected length just over three-fifths of the projected breadth. The glabella is broader than long in the ratio 5 : 4, bounded by narrow axial furrows which are straight and slightly convergent forwards over the hindmost two-thirds of their length, becoming curved and slightly more convergent frontally. There are three unequal pairs of glabellar lobes, their dorsal convexity continuous with that of the median body of the glabella. The third glabellar lobes are the largest, subtriangular in plan with rounded margins, and connected to the median body by narrow (*exsag.*), slightly depressed " necks "; posteriorly their convex margins invade the lateral thirds of the occipital ring. The third glabellar furrows are broad (*exsag.*), moderately deep, and curve inwards and moderately backwards ; each traverses about one-third of the glabellar breadth and broadens (*exsag.*) a little before ending almost level with the centre of the third glabellar lobes. The second glabellar lobes are relatively large, parallelsided, only slightly shorter (*exsag.*) than the third lobes, and end in tips which are gently rounded abaxially. The second glabellar furrows are parallel to those of the third pair and end longitudinally in-line with them, but are of uniform breadth (*exsag.*) adaxially. The first glabellar lobes are the smallest, just over half the length (*exsag.*) of the second lobes, but they also are parallelsided, delimited anteriorly by poorly-defined first glabellar furrows. The inner ends of the latter appear to line up with those of the other glabellar furrows, but as far as can be judged from the coarsely granulated state of preservation, their outer ends do not quite attain the axial furrows. The frontal glabellar lobe is small, subtrapezoidal in plan with the lateral margins strongly convergent forwards to broadly rounded anterolateral angles ; it is about five times as broad (*tr.*) as long, and the anterior margin is transversely almost straight, with a suggestion of being concave medially. The frontal margin of the cranidium is convex forwards and broadly rounded in plan. The anterior area (see Whittard 1960 : 143) is relatively short (*sag.*), between one quarter and one fifth of the projected median length of the cephalon, as well as broad (*tr.*), extending laterally until level with the hindmost parts of the axial furrows. Consequently the cranidial outline lacks the almost pointed, triangular appearance found in so many other species of the genus. In transverse section the anterior area appears gently declined overall, its surface gently and evenly convex. The anterior furrows forming the lateral boundaries of the anterior area are broad and shallow, markedly divergent forwards from the frontal ends of the axial furrows, the junction of the two marking the site of a pair of faint hypostomal pits. The occipital ring has a median length (*sag.*) one-quarter of that of the glabella. It is parallelsided over its median third but becomes narrower (*exsag.*) abaxially and curves forwards to form a pair of occipital lobes. The median third of the occipital furrow is transversely straight and shallow but the outer portions are slightly deeper, flexing gently backwards and then forwards again around the basal glabellar lobes. The eyes are known only from the palpebral lobes, which are moderately convex in plan, converge forwards, and have almost flat dorsal surfaces. There are no visible palpebral furrows and only slight traces of ocular ridges running from the front of the palpebral lobes towards the frontal glabellar lobe. The anterior ends of the palpebral lobes are level with the first glabellar furrows, and the lobes terminate opposite the posterior half of the second glabellar lobes. The anterior branches of the facial suture are slightly more convergent forwards than the axial furrows, and cut the cephalic margin level with the outer ends of the basal glabellar lobes. The distance from the outer edge of each palpebral lobe to the axial furrow is about half the glabellar breadth measured across the second glabellar furrows, so that the frontal parts of the fixigenae appear relatively large and broad. The inner halves of the fixigenae are only moderately declined but the abaxial portions curve downwards strongly. In plan the posterior parts of the fixigenae appear almost quadrant-shaped and the posterior branches of the facial suture curve evenly and strongly backwards from the eyes. The pleuroccipital furrow is uniformly deep and broad (*exsag.*), transversely straight as far as the fulcra but then curves gently forwards. The pleuroccipital segment is parallelsided as far as the fulcra but becomes slightly wider (*exsag.*) towards the incompletely-known genal angles.

The pygidium is strongly convex transversely, with the dorsal surface of the axis steeply declined posteriorly. The outline is of the " taut bow " type, ending in a bluntly-pointed tip, with the length three-quarters of the projected breadth. The axis has a frontal breadth slightly less than half that of the pygidium, and its straight sides converge backwards at between thirty and thirty-five degrees towards the convex terminal piece. The axial furrows die out near the axial tip and there is a broad (*tr.*) postaxial ridge. In addition to the articulating half-ring there are six axial rings, the first three of which are slightly convex forwards and the remainder transversely straight. They are separated by ring furrows which are broad (*sag.*) medially but become narrower and shallower towards the axial furrows. The side-lobes carry, in addition to the anterior half-rib, five pairs of well-defined ribs and traces of a sixth pair. The pleural furrows separating the ribs are deep and narrow (*exsag.*), and all curve backwards, at first moderately and then more strongly, from the axial furrows to intersect the lateral margins. The outermost parts of the furrows, possibly coinciding with the limits of the pygidial doublure, are notably shallower, and the pairs of furrows become more strongly directed backwards from the first to sixth, until those of the last pair are subparallel. The interpleural furrows are only faintly impressed between the axial furrows and the fulcra, but their outermost portions are more deeply incised except near the pygidial margin, where they again become fainter. The pleural furrows divide the pygidial pleurae into anterior and posterior bands of which the former are conspicuously the narrower (*exsag.*). The anterolateral portions of the first pleura are strongly deflected ventrally to form a pair of large facets.

The Couches du Landeyran supérieures have yielded a few specimens of a small form of *Neseuretus*, for example at locality $\lambda 2$, in the lowest strata of this subdivision, and at localities $\lambda 16$, $\lambda 17$ and $\lambda 22$. At first it was suspected that these represented nothing more than immature individuals of *Neseuretus antetristani*, but the suggestion has been discounted for a number of reasons : (i) the surface of the test is covered with fine granules ; (ii) the pleural furrows of the pygidium are better defined abaxially than in *N. antetristani* ; (iii) no intermediate stages have yet been found. Most important of all, one of the small cephala, In. 57755, retains part of the rostral plate and it can be seen that the frontal portion of the facial suture is submarginal, and not supramarginal as in *N. antetristani*. The specimens agree better with *Neseuretus arenosus* in the rather squat glabellar outline and shortness of the anterior border, and the fact that the latter appears more steeply upturned probably results from preservation in an argillaceous matrix. Two small pygidia from the Couches du Landeyran supérieures, though indifferently preserved, agree fairly well with that of *N. arenosus*. In the absence of good confirmatory evidence, all these specimens are listed in the present paper as *Neseuretus* cf. *arenosus*.

Discussion. The oft-quoted species *Neseuretus tristani* was described by Brongniart (1822 : 12, pl. 1, figs. *2a–k*) from the Schistes à Calymènes (mostly Upper Llanvirn Series) of the Cotentin Peninsula, western Normandy. Photographs of the type material have been published by Pompeckj (1903) and it is clear that the species is quite distinct from any yet found in the Montagne Noire. The glabellar outline of *N. tristani* is more rounded frontally and less convergent than that of *N. antetristani*, with better defined glabellar furrows. In *N. tristani* the paraglabellar areas are well developed and depressed below the level of the fixigenae, and consequently the posterior portions of the axial furrows appear less sharply defined than those of *N. antetristani*. In addition the anterior area of the Cotentin species is longer and more convex forwards than that of *N. antetristani*, whilst the rostral suture occupies a slightly inframarginal position. *Neseuretus arenosus*, although possessing well-defined glabellar furrows, is easily distinguished from species such as *N. tristani* by its squatter glabellar outline and shorter, only slightly convex, anterior area.

Whittard (1960 : 138–151) has described or redescribed several species of *Neseuretus* from the Shelve Inlier of West Shropshire, the majority of them occurring in the Arenig Series. All these species have deeply incised glabellar furrows and in most cases the anterior area is both longer and more sharply defined than in *Neseuretus antetristani*, but one of the paratypes of *N. brevisulcus* Whittard (1960, pl. 19, fig. 13) is of particular interest in exhibiting a pair of anterolateral expansions of the frontal glabellar lobe, separated by a median indentation, features reminiscent of the French species.

The only species of *Neseuretus* illustrated previously from the Ordovician rocks of the Montagne Noire was described by Thoral (1935*a* : 277, pl. 19, figs. 4*a*, *b*) as *Calymmene* [*sic*] (*Synhomalonotus*) *bergeroni*. Thoral's species was founded on material said to be from both the Tremadoc and Arenig Series, particularly in the St. Chinian and Prades-sur-Vernazobres districts ; the single specimen figured by Thoral, and now in the Bergeron Collection at the Sorbonne, is chosen here as lectotype. The glabellar outline of this apparently small species is reminiscent of that in *Neseuretus arenosus*, but the foremost part of the cephalon is markedly different, consisting of a low, sharply upturned brim separated from the frontal glabellar lobe by a deep, almost transversely straight furrow. The pygidium of *N. bergeroni* is fairly distinct, having side-lobes with only the first two pairs of ribs clearly defined. No specimens undoubtedly referable to *Neseuretus bergeroni* have yet been found in the Landeyran Valley district and the small specimens of *Neseuretus* noted earlier in this account as *N.* cf. *arenosus* have a distinctively longer anterior area and better segmented pygidium than Thoral's species.

In describing *Calymene* (*Synhomalonotus*) *attenuata* from the Ordovician of Morocco, Gigout (1951 : 289, pl. 3, figs. 6, 7) stated that the species appeared to be present in the Montagne Noire, in the shales of Cabrières and in the sandstones above the Grès à Lingules. He claimed that the French material (in collections made by Thoral) had dimensions and glabella similar to those of *C.* (*S.*) *attenuata* but that the " bourrelet " (presumably corresponding to the anterior area) was raised up without being prolonged into a rostrum, a difference which he considered might be due to imperfect preservation. Monsieur J. Destombes has kindly supplied me with a photograph of Gigout's holotype and has given me a topotype cranidium which is now figured for comparison (Pl. 14, figs. 2, 6, 12). Both show that *C.* (*S.*) *attenuata* undoubtedly belongs to *Neseuretus* and I consider it to be specifically distinct from the specimens from above the Grès à Lingules, which are now described as *Neseuretus arenosus* sp. nov. The glabella of *N. arenosus* is proportionately shorter and less convergent forwards than that of *N. attenuatus*, and the frontal glabellar lobe is both shorter and broader, with no " step " in the glabellar outline at the first glabellar furrows. The anterior area of *N. attenuatus* is longer, narrower and more strongly arched transversely than that of *N. arenosus*, and whilst such differences could possibly be accounted for by vagaries of preservation (though this is considered unlikely), the anterior area of the Moroccan species is convex over its posterior half, becoming concave towards the raised cephalic margin, features contrasting markedly with the short, uniformly convex anterior area of *N. arenosus*. The age of *N. attenuatus* was stated originally by Gigout to be " Llandeilo " (in fact, upper Llanvirn), but in a more recent revision of the appropriate stratigraphy the species is recorded from the Lower Llanvirn Series (Gigout 1956 : 2740), that is to say an horizon later than that of *N. arenosus* in the Montagne Noire.

A species of *Neseuretus* resembling *N. arenosus* in some respects is that described originally as *Calymene* (*Synhomalonatus*) [*sic*] *convexia* from the Llanvirn Series of south-western China (Sheng 1958 : 201, pl. 7, fig. 6). Sheng's illustration makes it difficult to discern the glabellar outline of *Neseuretus convexius*, though it seems broadly comparable to that of *N. arenosus*, but both species share a relatively short (*sag.*) anterior border and fixigenae which are noticeably broad frontally. The test of *N. convexius*, like that of specimens of *N.* cf. *arenosus* from an argillaceous matrix in the Landeyran Valley, is finely granulated, but the eyes of the Chinese species are sited opposite the first glabellar lobes, or even part of the frontal glabellar lobe, that is to say conspicuously farther forwards than in the French form. *Neseuretus tungtzuensis* Sheng (1958 : 200, pl. 7, figs. 5a–c), from a horizon similar to that of *N. convexia* was said by Sheng to be closely related to the latter species, but appears to be quite distinct from both it and *N. arenosus* on account of the narrower, straight-sided, less convergent glabellar outline and much longer anterior area.

Family **EOHOMALONOTIDAE** Hupé 1955

Genus ***PLATYCORYPHE*** Foerste 1910

Platycoryphe convergens sp. nov.

(Pl. 14, figs. 3, 10, 13)

DIAGNOSIS. Species of *Platycoryphe* with sub-trapezoidal glabellar outline, narrowing forwards slightly. No distinct glabellar furrows but position of glabellar lobes indicated by three pairs of indentations along sides of glabella. Eyes situated opposite first glabellar lobes. Anterior border short, inclined.

HOLOTYPE. Brit. Mus. (Nat. Hist.) In.57756.

LOCALITY AND HORIZON. The only known specimen is from locality λ19, on the hillside south-east of Route D. 136, near the southern end of the Landeyran Valley. The horizon is in the Couches du Landeyran supérieures.

DESCRIPTION. Cranidium slightly less than twice as broad as long. The glabella is only moderately convex, both longitudinally and transversely, but stands noticeably higher than the fixigenae. In outline it is sub-trapezoidal, with frontal breadth slightly more than half the basal breadth. There are no distinct glabellar lobes and furrows, but their position is indicated by three pairs of small constrictions of the sides of the glabella. Those representing the third glabellar furrows are situated about three-eighths of the distance from the back to the front of the glabella, but the first and second furrows are slightly closer together, marking first and second pairs of glabellar lobes, each equal to about one-quarter of the length of the glabella. The indentations become progressively less marked from back to front of the glabella, whilst the first glabellar lobes are slightly more convex than those of the other pairs. There is a faint suggestion of a median carination of the glabella, and although such a feature is not uncommon in homalonotid trilobites its presence here may well be due to crushing, which is particularly visible on the right side of the glabella. The axial furrows are deep and well defined, apparently without constrictions corresponding to the glabellar furrows. This is so in the case of the left axial furrow, and the flexures of the right furrow are probably due to mechanical causes. There is no definite evidence of hypostomal pits. The frontal glabellar lobe is twice as broad as long, gently convex frontally and rounded anterolaterally. At either side it is strongly defined by the axial furrows, but the latter diminish forwards and form only a shallow groove antero-medially, representing the preglabellar furrow. The anterior border is short and thin, with a sharp dorsal edge, and strongly upturned with a slight suggestion of thickening at and near the sagittal line. There is no anterior border furrow or discrete preglabellar field, but the area immediately in front of the glabella is slightly flattened, and broadens laterally towards the axial furrows. This can be seen on the right side of the holotype, but the left side of the same specimen appears to show a short (*tr.*) extension of the fixigena in front of the frontal glabellar lobe. The occipital ring is longest (*sag.*) medially, where it is equal to almost one-sixth of the glabellar length, narrowing (*exsag.*) laterally to form a pair of small occipital lobes. The occipital furrow is well defined transversely straight and deepens laterally. The pleuroccipital segment is narrow (*exsag.*) proximally but broadens a little towards the genal angles. The pleuroccipital furrow is transversely straight, narrow and deep outside the axial furrows, becomes wider and shallower abaxially, its outer ends incompletely preserved. The eyes and palpebral lobes are not preserved, but were sited well forwards, opposite the first glabellar lobes and only a little way out from the axial furrows. The anterior parts of the fixigenae are thus relatively short and narrow, bounded by the anterior branches of the facial suture which run forwards from the eye, parallel to the axial furrows, to cut the anterior border and curve inwards, passing below the top of the border. The posterior parts of the fixigenae are long (*exsag.*), convex, steeply declined laterally, and the posterior branches of the facial suture curve backwards, gently at first and then more strongly, from the eyes to cut the cephalic margin in what appears to be a gonatoparian position, though the genal angles are incomplete. The librigenae and the remainder of the exoskeleton are not preserved. The surface of the test appears to be generally smooth, as far as can be judged, and the apparent granulation of the internal mould is due to the state of preservation.

Discussion. The new species belongs to a group of trilobites which had a long history and wide distribution during Ordovician times, though they have previously been unrecorded from strata below the Llanvirn Series. Whittington's (1965) illustrations show that all the known North American species have well-defined glabellar furrows, but in some individuals described from the Caradoc Series of South Shropshire (Dean 1961 : 344) they may become diminished. Certain specimens of *Platycoryphe vulcani* (Murchison), redescribed by Whittard (1961 : 164) from the Llanvirn Series of West Shropshire, have a smooth glabella, reminiscent of that of *Brongniartella*, whilst others of the same species have easily visible glabellar furrows.

Paraglabellar areas do not appear to be developed in the Landeyran Valley species. Such structures have been described in *Platycoryphe dentata* Dean (1961 : 340) from South Shropshire, as well as by Whittington (1965) in the type-species *P. christyi* (Hall). On the other hand paraglabellar areas are visible on certain specimens of *Platycoryphe vulcani* (see Whittard 1961, pl. 22, figs. 8, 12) though not in others, and were not mentioned in the description of the species. A similar state of affairs exists for *Brongniartella*, only occasional specimens of which exhibit well-defined paraglabellar areas. The steeply upturned nature of the anterior border in *Platycoryphe convergens* is possibly mechanical in origin. At all events it contrasts markedly with the rather flattened, scoop-like structure of *Platycoryphe vulcani*, and the thickened, though upturned, border of *P. christyi*. In *P. vulcani* the eyes are sited opposite the second, and part of the first, glabellar lobes, and in the other described species opposite the second lobes, whereas those of *P. convergens* are placed relatively far forwards, in line with the first glabellar lobes. The anterior margin of the frontal glabellar lobe is more rounded in plan and less well defined than in any other described species of the genus.

A trilobite of homalonotid type was described by Kobayashi (1937 : 490, pl. 3, figs. 15–17) as *Homalonotus* (*Brongniartella?*) *bistrami* Hoeck, from the Ordovician (?Lower) of Bolivia. Harrington & Leanza (1957 : 224) have pointed out that the pygidium of this form is unlikely to be that of a true *Brongniartella*, and one might add that the associated cephala illustrated by Kobayashi bear some resemblance to that of *Platycoryphe*, although the material is distorted and difficult to evaluate.

Family **ASAPHIDAE** Burmeister 1843

Subfamily **ASAPHINAE** Burmeister 1843

Genus ***BASILIELLA*** Kobayashi 1934

Basiliella mediterranea sp. nov.

(Pl. 16, fig. 5 ; Pl. 17, figs. 1, 3, 4, 8, 11–13)

Diagnosis. Glabella moderately convex, broadest basally, narrowing medially but expanding to well-rounded frontal lobe. One pair large, triangular glabellar lobes present, their anterolateral ''angles'' slightly depressed. Eyes placed opposite centre of glabella. Facial suture dorsal-intramarginal with anterior branches moderately divergent forwards, meeting frontally at obtuse angle. Preglabellar field narrow (*sag.*), slightly convex. Anterior border forms narrow rim. Small median tubercle sited in front of occipital furrow. Librigenal spines long, slim. Hypostoma with posterior border deeply notched. Thorax of eight segments. Pygidium semicircular in outline with concave border ; nine or ten axial rings and seven pleural ribs present.

Holotype. Brit. Mus. (Nat. Hist.) It.399 (Pl. 17, figs. 1, 4).

Paratypes. In.56847 (Pl. 17, fig. 3) ; In.56856 (Pl. 17, figs. 11, 13 ; It.257 (Pl. 16, fig. 5 ; Pl. 17, fig. 8) ; It.260 (Pl. 17, fig. 12).

Localities and horizons. Most of the type-material of this uncommon species is from the Couches du Landeyran supérieures cropping out along the eastern side of the Landeyran Valley. The holotype was obtained from locality $\lambda 21$ and two of the paratypes from $\lambda 8$ and $\lambda 17$, but the species was found also at $\lambda 19$. *B. mediterranea* occurs, though rarely, in the Couches du Landeyran inférieures and one of the paratypes is from locality $\lambda 31$ at the hillside section 240 metres south-west of Le Foulon.

Description. The glabella is moderately convex both longitudinally and transversely, and has a basal breadth about five-sixths of the median length. It is well rounded frontally but narrows opposite its mid-point to about five-sixths the frontal breadth, resulting in a waist-like appearance ; the glabella then expands again, reaching a maximum at its base, where the breadth is one and a quarter times that of the frontal lobe. There is a single pair of large, basal, glabellar lobes, triangular in plan, with their anterolateral portions depressed slightly below the level of the adjacent glabella. The glabellar furrows are straight and broad (*tr.*), run sharply backwards adaxially from the axial furrows at points opposite the centre of the glabella, and end abruptly so as to leave a narrow, unfurrowed, median band. A slight flexure affects the left, but not the right, basal glabellar furrow of the holotype and is apparently the result of crushing. The axial furrows are broad, moderately deep, become shallower at their mid-points, opposite the outer ends of the basal glabellar furrows, and fuse frontally with the preglabellar furrow. There is a gently convex preglabellar field, narrow (*sag.*) medially but broader abaxially and merges with the frontal portions of the fixigenae. It is bounded frontally by a broad (*sag.*), shallow, anterior border furrow, in front of which is developed a narrow, rim-like, anterior border. The occipital furrow is only moderately impressed medially, then becomes deeper, possibly due to the presence of a pair of apodemes, and finally markedly shallower at its extremities. The occipital ring is parallelsided with only a suggestion of a pair of occipital lobes ; the latter scarcely extend level with the outer margins of the basal glabellar lobes and are poorly differentiated from them. Both the occipital furrow and ring of the holotype appear to be flexed forwards abaxially but this has probably been exaggerated by crushing. The pleuroccipital furrow is broad (*exsag.*), moderately deep, curves backwards a little abaxially, whilst the pleuroccipital segment expands only slightly in size towards the genal angles. The palpebral lobes, although incompletely known, are moderately convex, their dorsal surfaces gently declined adaxially, sited a little behind centre with reference to the glabella, and immediately outside the axial furrows. One of the paratypes retains the left librigena and although this is displaced it can be seen to end in a long, slim, curved, librigenal spine which must have extended backwards as far as the anterior half of the pygidium. The eye is reniform, convex, and the visual surface is holochroal, though only a fragment is preserved. No distinct eye-platform is developed and the surface of the librigena declines steeply from the eye to a broad, smooth furrow, beyond which is a raised, narrow, lateral border. The surface of the cephalic margin and doublure at this point is ornamented with closely-grouped, subparallel terrace-lines. The anterior branches of the facial suture curve forwards and outwards from the eyes almost to the anterior border furrow ; there they turn through about a right-angle, cut the anterior border obliquely and curve smoothly inwards. Near the sagittal line they turn forwards slightly before meeting at an obtuse angle, so that on the cranidium the median part of the anterior border is bluntly pointed. The posterior branches curve backwards abaxially, at first gently and then more sharply, probably cutting the posterior cephalic margin outside the fulcra. Apart from the terrace-lines of the cephalic margin and doublure already mentioned, the test is smooth.

One of the paratypes (Pl. 16, fig. 5 ; Pl. 17, fig. 8) retains the hypostoma almost in place. Although the anterior portion is incomplete, the entire hypostoma is estimated to have had a maximum breadth almost equal to the length. The frontal margin appears to have been rounded in plan and no trace of an anterior border has been found. The lateral margins are rounded and the overall breadth of the hypostoma increases from front to back for about three-quarters of the length, coinciding with a progressive broadening of the lateral border. The latter is flattened and continues backwards as a pair of large, posterior wings, separated by a median notch whose depth is estimated as about one-eighth of the entire length of the hypostoma. The median body is large, convex, ovoid in plan and narrows posteriorly. It is bounded laterally by a broad, deep furrow which continues posteriorly so as to delimit the posterior border, and runs transversely a short distance in front of the median notch. The median body is traversed by a curved median furrow, concave forwards and shallowest medially. The two lobes so formed are markedly unequal, the median length of the anterior being about six times that of the posterior lobe. The latter is subcrescentic in plan, expanding a little abaxially where the antero-lateral halves show traces of a pair of maculae.

An isolated hypostoma, It.269 (Pl. 17, fig. 9) from locality $\lambda 32$, is referred tentatively to *B. mediterranea* and resembles that of paratype It.257 in many respects, but the median body has a slightly larger posterior lobe and the posterior border is indented by a narrower median notch. In this last feature the specimen resembles another hypostoma, In.57742 (Pl. 17, fig. 6), here named only *Basiliella* sp., from locality $\lambda 17$, but the latter has an almost circular anterior lobe. Yet another hypostoma referred to *Basiliella*, In.56844 (Pl. 17, fig. 2) also from $\lambda 17$, is larger than the other specimens and differs from them in having an extremely broad, deep, median notch in the posterior margin, a less well-defined posterior lobe, and more pointed posterior wings.

The thorax comprises eight segments and the axis, which stands well above the side-lobes, occupies a little less than one-third of the total projected breadth. The axial rings are transversely rectangular in plan, bounded laterally by deep, broad, axial furrows. The pleurae are parallelsided and transversely straight for half their length (*tr.*) but then turn backwards slightly to the pleural tips which are obliquely truncated and form short points directed posterolaterally. Each pleura carries a pleural furrow which begins just outside the axial furrow and is shallow at first, becomes deeper as it traverses the fulcrum but shallows again and dies out mid-way between the fulcrum and the pleural tip. The anterior band has a narrow (*exsag.*), ridge-like appearance at and near the fulcrum owing to the development of a large, articulating facet anterolaterally.

The pygidium is slightly convex, one and a half times as broad as long. The anterior margin arches gently backwards and outwards from the axis to well-rounded anterolateral angles, behind which the lateral margins run backwards and inwards so that the outline forms a broad, smooth, parabolic curve. The axis is narrow, its frontal breadth just less than a quarter of that of the pygidium and its sides slightly convergent backwards, bounded by straight, deep axial furrows. The available material shows nine or ten transversely straight axial rings, followed by a narrow, blunt, almost smooth tip. The latter is separated from the posterior margin of the pygidium by a concave border which is narrow (*sag.*) posteriorly but widens antero-laterally before becoming slightly narrower near the frontal margin of the pygidium, where a pair of facets is situated. There is no postaxial ridge. The side-lobes curve gently downwards from the axial furrows and carry, in addition to the anterior half-rib, seven pairs of ribs, the seventh pair being less distinct than the others, followed by a small, unfurrowed area on either side of the axial tip. The pleural furrows are straight for most of their length (*tr.*), but curve backwards slightly just before attaining the inner side of the lateral border, where they end. The ribs are a little wider at their outer ends, become progressively more strongly directed backwards from front to back of the pygidium, and are flattened dorsally, with only faint traces of interpleural furrows.

DISCUSSION. *Basiliella* was founded by Kobayashi (1934 : 469) on *Asaphus barrandi* Hall 1851 (sometimes misquoted as *A. barrandei* sic) and used by him for certain South Korean trilobites. Since then specimens of Upper Tremadoc age have been assigned to the genus (Harrington 1938 : 257 ; Harrington & Leanza 1957 : 145). All these species have a conspicuous axial ridge across the preglabellar field, a feature which is absent from the type-species as illustrated by Hall (1851 : 210) and Raymond (1914 : 261), and there must be some doubt as to their true generic position. Jaanusson (*in* Moore 1959 : O 336) has redefined *Basiliella*, regarding it as a subgenus of *Basilicus*, and has given new line-drawings of the type-species of both genera. He shows the cephalon of *Basiliella* with longer librigenal spines, more divergent anterior branches of the facial suture, and less pointed posterior wings on the hypostoma than *Basilicus*. He emphasizes, however, the short, broad, almost semicircular pygidium of *Basiliella*, a feature which Kobayashi (1934 : 469) had regarded as being of generic significance, contrasting markedly with the long, subtriangular, better-segmented pygidium of *Basilicus*. *Basiliella mediterranea* agrees in all essentials with *B. barrandi* (Hall), but may be distinguished by the following features : (i) the anterior branches of the facial suture are less divergent forwards ; (ii) the basal glabellar lobes are larger and better defined, so that the posterior half of the glabella is notably wider ; (iii) the occipital furrow is deeper and curved, whilst the median tubercle immediately in front of it is smaller ; (iv) the librigenal spines are slimmer and longer. Jaanusson's restoration of the cranidium of *Basiliella barrandi* shows the frontal margin as an unbroken curve, but Raymond's figures illustrate clearly the intramarginal facial suture, with the two branches curving forwards slightly near the sagittal line to meet at an obtuse angle. A similar feature is seen in *B. mediterranea*, though the anterior border is probably rather narrower (*sag.*). The various illustrations of the pygidium of *B. barrandi* are somewhat contradictory, but there appear to be more pleural ribs than in the French species, though the number of axial rings seems at least roughly comparable. Hall's original material of *Basiliella* came from the Black River group of Wisconsin and is therefore considerably younger than the specimens from the Montagne Noire.

Subfamily **ISOTELINAE** Angelin 1854

Genus ***MEGISTASPIS*** Jaanusson 1956

Subgenus ***EKERASPIS*** Tjernvik 1956

Megistaspis **(*Ekeraspis*)** sp.

(Pl. 16, figs. 2, 9, 10)

Ekeraspis was first established by Tjernvik (1956 : 242) as a subgenus of *Plesio-*

megalaspis, but has since been claimed as a subgenus of *Megistaspis* by Jaanusson (*in* Moore 1959 : O 349), whose convention is followed here. According to Jaanusson, in *Megistaspis* the glabella is parallelsided or tapered, there is a concave cephalic border, and the " frontal area " occupies at least 25% of the length of the cranidium. The anterior branches of the facial suture of the type-species of *Megistaspis* and *Ekeraspis* differ markedly, those of the former diverging forwards only slightly before curving inwards and meeting well forwards at an acute angle. In *Ekeraspis* the anterior branches diverge forwards more strongly as far as the cephalic border, where they turn sharply inwards and meet frontally at an obtuse angle. A few cranidia, the largest with a median length of about 25 mm., from the Landeyran Valley–Le Foulon district exhibit all these features, and differ in only small respects from the type-species *M.* (*E.*) *armata* (Tjernvik 1956 : 242), described from the early Arenig Series of Sweden. The French specimens have slightly less divergent anterior branches of the facial suture, the poorly differentiated frontal glabellar lobe is broader, and the eyes are positioned a little farther forwards. The pygidium of *M.* (*E.*) *armata* is a distinctive structure with a broad, concave border which becomes still broader posteriorly and merges with a stout terminal spine. No comparable pygidium was found during the present collecting, but the pygidium of *Megalaspis filacovi* Munier-Chalmas & Bergeron (see Thoral 1935*a* : 226), from the Upper Tremadoc Series of the St. Chinian district, is of closely similar type, though smaller and generally with a longer, slimmer, terminal spine. Two small, slightly compressed pygidia (Pl. 15, figs. 5, 6, 8), each ending in a small spine, are provisionally assigned to *Ekeraspis*. The axis is narrow with traces of seven or eight axial rings, whilst the side-lobes carry at least five pairs of ribs which become fainter posteriorly. The border is smooth and broad but not concave, though this may have been obscured by compression. A more satisfactory determination must await the collection of further specimens.

A single, large hypostoma (see Pl. 16, fig. 11) from an unspecified horizon and locality in the Landeyran Valley almost certainly originated from the Couches du Landeyran. It bears a considerable resemblance to one figured by Thoral (1935*a*, pl. 25, fig. 2) as *Megalaspis* (?) sp., from the Upper Tremadoc or Lower Arenig of the St. Chinian district. Thoral considered such forms to be related to his species *Megalaspis* (?) *boehmi*, but the hypostoma of the latter, though generally similar (Thoral 1935*a*, pl. 27, fig. 4), differs from the present specimen in having the margins of the anterior lobe more strongly convergent backwards, so that the maculae are situated closer together. In the absence of additional material the specimen is referred merely to *Megistaspis* (s.l.).

Genus ***MEGALASPIDELLA*** Kobayashi 1937

Subgenus ***MEGALASPIDELLA*** Kobayashi 1937

1946. *Plesiomegalaspis* Thoral : 61.

Megalaspidella (***Megalaspidella***) sp.

(Pl. 16, fig. 12 ; Pl. 17, fig. 7)

According to Thoral (1946 : 70) *Paramegalaspis*, although closely resembling

Plesiomegalaspis, is always smaller and more convex, and has less well developed borders, whilst the pygidial axis is very indistinct. Future revision may well show these criteria to be insufficient for generic separation, but for the present I follow Jaanusson (*in* Moore 1959 : O 347, O 349) in regarding *Plesiomegalaspis* as a probable synonym of *Megalaspidella* sensu stricto and distinct from *Paramegalaspis*.

The type-species of *Plesiomegalaspis*, *P. graffi*, was described by Thoral (1946 : 61) from the Cabrières district, north-east of the Landeyran Valley, where it occurs commonly in association with *Niobella fourneti* (Thoral), raphiophorids and agnostids. Such an assemblage suggests that one might expect to find the genus in at least the Couches du Landeyran inférieures, but several large specimens of appropriate type which were collected proved too distorted for certain identification. A small cephalon preserved as an internal mould (Pl. 16, fig. 12) shares most essential features with *M. graffi* but has rather larger eyes than that form, though this may be due to its representing an earlier stage of development. The unthickened anterior border is certainly like that of Thoral's species, whilst both have the anterior branches of the facial suture diverging forwards more strongly than has a typical *Paramegalaspis*.

A large hypostoma (Pl. 17, fig. 7) from the Couches du Landeyran inférieures near Le Foulon has an elongated, elliptical median body, cut abaxially by the deep, outer ends of an otherwise shallow, transverse, median furrow. The centre of the posterior margin is marked by a short point, separated by small indentations from broad posterior wings which do not extend backwards beyond the median point. The hypostoma strongly resembles that of *Megalaspidella* [*Plesiomegalaspis*] *graffi* but is relatively narrower. One of Thoral's syntypes of the *forma typica* of his species (1946, pl. 12, fig. 1*a*) shows the posterior margin of the hypostoma with a small median notch, but the photographs of *M. graffi* var. *major* and *M. angustirachis* (Thoral 1946, pl. 7, fig. 1 and pl. 16, fig. 2) indicate a small, median point.

Genus ***PARAMEGALASPIS*** Thoral *in* Jaanusson 1956

1935*a*. *Paramegalaspis* Thoral : 238. *Nomen nudum.*

Paramegalaspis cf. ***frequens*** Thoral

(Pl. 18, figs. 1–3, 8, 10, 13)

1935*a*. *Paramegalaspis frequens* Thoral : 243.

The remains of asaphid trilobites are relatively common in the Couches du Landeyran. Unfortunately they are usually disarticulated and too distorted for certain identification, but the majority probably belong to *Paramegalaspis*. Much of the material assigned to this genus by Thoral was preserved as internal and external moulds in siliceous nodules, and a few similar examples have been found in the Landeyran Valley. A pygidium (Pl. 18, figs. 2, 10, 13) in a loose nodule from, probably, the Couches du Landeyran inférieures, has traces of about eight axial rings and six pleural ribs, figures which are appropriate for *P. frequens*, but the anterior margin is straighter than that of the latter species and the lateral border is slightly less well defined.

An unfigured cranidium, In.57738, from a loose nodule near locality λ17, is closely similar to that of *Paramegalaspis immarginata* Thoral (1935*a* : 248) but the eyes are sited a little farther forwards. Like *P. immarginata* this specimen has an almost obsolete anterior border, but a larger cranidium (Pl. 18, figs. 1, 3, 8) from the same vicinity is similar in most respects except that of the anterior border. The latter is more strongly developed and the frontal glabellar lobe and preglabellar field are better defined, such features being more appropriate to *Paramegalaspis frequens* or one of its varieties. A revision of *Paramegalaspis* is beyond the scope of the present paper, but one cannot rule out the possibility of variation within the various species, and allegedly diagnostic features might well be at least partly dependent on the size of the specimen. The genus was described from both the Tremadoc and Arenig Series by Thoral, so it might be expected to occur in the strata below the Couches du Landeyran. Such evidence is, in fact, scanty but a hypostoma (Pl. 18, fig. 9) from the Couches du Foulon agrees with Thoral's (1935*a* : 239) diagnosis of *Paramegalaspis*, though the median furrow is slightly deeper than stated by him.

Two small pygidia figured here (Pl. 18, figs. 11, 12) are typical of several collected from both the lower and upper subdivisions of the Couches du Landeyran. Although crushed to varying degrees they resemble the pygidium of *Paramegalaspis* in all essentials, whilst the broad, smooth border is similar to that of *P. frequens* var. *depressa* Thoral (1935*a* : 247).

Numerous immature specimens of *Paramegalaspis* were obtained from the Couches du Landeyran, and although most had suffered from the effects of weathering, a few fairly well-preserved examples were recovered, particularly at localities λ16 and λ30. The smallest (Pl. 17, fig. 5), which probably represents Meraspis Degree 3, has a cephalic length (*sag.*) and breadth of 1·6 mm. and 3·0 mm. (estimated) respectively. The area in front of the glabella is smooth and undivided, whilst the glabella is more convex and the eyes larger than in the adult. Slim librigenal spines extend at least level with the centre of the pygidium, which has a broad, smooth border and poorly differentiated ribs. Meraspis Degree 4 (Pl. 17, fig. 14) resembles Degree 3 in most respects, but has a slightly shorter transitory pygidium. In Meraspis Degree 6 (Pl. 17, fig. 15) the length and breadth of the cephalon are 2·1 mm. and 3·6 mm. (estimated) respectively, whilst the total length of the exoskeleton is about 4·8 mm. The eyes are still relatively large, and the librigenal spines are unusually long, extending a little beyond the tip of the pygidium. Pl. 17, fig. 10 probably represents Meraspis Degree 7, and the total length is about 7·1 mm. The eyes are smaller and the pygidial border is narrower than those of earlier growth stages. The librigenal spines, though not entirely preserved, give the impression of being notably shorter than those of Degree 6 described above, and there may have been some variation in their length.

Genus *HOEKASPIS* Kobayashi 1937

Hoekaspis*? *quadrata sp. nov.

(Pl. 19, figs. 1–10, 12)

Diagnosis. Glabella subrectangular, longer than broad, with frontal margin slightly convex. Anterior border well defined, broadens (*sag.*) a little medially, separated from glabella by deep furrow of even breadth. Occipital and pleuroccipital furrows deep, almost straight. Palpebral lobes unfurrowed, convex, sited well back, close to axial furrows, their length half that of glabella.

Holotype. Brit. Mus. (Nat. Hist.) It.428 (Pl. 19, figs. 1, 3, 5, 7–9).

Paratypes. It.429 (Pl. 19, figs. 2, 4, 6, 12) ; It.430 (Pl. 19, fig. 10).

Locality and horizon. Locality λ6 in the south-eastern bank of the river near the northern end of the Landeyran Valley. The horizon is low in the Couches du Landeyran inférieures.

Description. The species is represented by only three associated, slightly compressed cranidia, each moderately convex transversely with its dorsal surface gently declined forwards, except when distorted mechanically. The glabella is longitudinally subrectangular in outline with the corners rounded, whilst the frontal margin is slightly convex. The glabella of the holotype, the largest specimen, is about five-sixths as broad as long, but that of the smallest example is conspicuously narrower, with the breadth only three-fifths of the length, and may represent an earlier stage of development. There are no glabellar furrows and the unfurrowed glabella is bounded by straight, nearly parallel axial furrows which are broad and deep for the most part but become shallower frontally, where a pair of hypostomal pits is situated on their inner margins, just behind the anterolateral angles of the glabella. The frontal part of the cranidium is formed by a well-developed anterior border with flattened dorsal surface and median breadth (*sag.*) about one-seventh of the length of the glabella, separated from the latter by a deep, parallel-sided furrow of similar breadth. The posterior margin of the anterior border is steeply bevelled and the front of the glabella is well defined but there is no development of a distinct, furrow-bounded, preglabellar field. The median two-thirds of the occipital ring are uniformly broad (*sag.*) but the ends are narrow and turn forwards slightly to form a pair of occipital lobes. The occipital furrow is deep and transversely straight except for the extremities which curve forwards around the posterolateral angles of the glabella. The pleuroccipital segment, though incompletely known, apparently broadens (*exsag.*) abaxially, and is delimited by a deep pleuroccipital furrow. The palpebral lobes are convex in plan and fairly large, their length (*exsag.*) half that of the glabella. They are placed just outside the axial furrows and end posteriorly a little in front of the line of the occipital furrow. Their dorsal surfaces decline gently towards the axial furrows. The anterior branches of the facial suture are straight and slightly divergent at first but then curve adaxially so as to cut the anterior border and meet frontally in a broad arc or at a very blunt point. The posterior branches run outwards and gently back for more than half their length (*tr.*) but then turn more sharply back to the posterior margin, so that the hindmost portions of the fixigenae are small and subtriangular. The surface of the test is smooth.

Discussion. *Hoekaspis* was founded by Kobayashi (1937 : 496) and has since been redefined by Harrington & Leanza (1957 : 176). The generic position of the scanty sample from the Landeyran Valley is by no means clear, but the species agrees with the definition of *Hoekaspis* in the following respects : (i) the glabella is almost rectangular in plan, bounded by broad axial furrows ; (ii) the anterior border is convex, set lower than the glabella and separated from it by a distinct furrow ; (iii) the facial suture is intramarginal. On the other hand, the occipital furrow, unlike that of other species of *Hoekaspis*, is well defined and the eyes are larger than in any other members of the genus, whilst the furrow separating the glabella and anterior border is unusually deep and broad (*sag.*), but this last feature may have been exaggerated by compression. No median tubercle has been found on the glabella of *H.? quadrata*, but this may be the result of poor preservation, and the same structure is not obvious in all of Harrington & Leanza's illustrations.

Subfamily **NIOBINAE** Jaanusson 1959

Genus ***NIOBELLA*** Reed 1931

In his original definition of *Niobella* Reed (1931 : 462–463) laid stress on the form of the hypostoma in separating the genus from *Niobe* sensu stricto, that of *Niobella* having a sub-pointed or rounded posterior margin. He regarded the pygidium as being virtually identical in both genera. Lake (1942 : 330), however, has questioned the significance of the hypostoma, demonstrating that the posterior hypostomal margin of *Niobe* (s.l.) underwent successive changes. More recently Tjernvik (1956 : 223, 228) has redescribed various members of both *Niobe* (including *N. frontalis* (Dalman) the type-species) and *Niobella* from the Lower Ordovician of Sweden. He has demonstrated that the pygidium gives a reliable means of separation, that of *Niobe* having ribs which are mostly rounded in cross-section, extending outwards beyond the inner margin of the doublure to end in tips which bulge abaxially, whilst the pygidium of *Niobella* has ribs which are well developed as far as the doublural margin and then merge into the flattened border. Tjernvik's illustrations suggest also that the eyes of *Niobe* are placed closer to the glabella, and that the lobation of the glabella is better defined than in *Niobella*. On the basis of these criteria most of, if not all, the species from the Montagne Noire hitherto assigned to *Niobe* should be transferred to *Niobella*.

Niobella fourneti (Thoral)

(Pl. 15, fig. 9)

1946. *Niobe fourneti* Thoral : 74–82, pl. 1 ; pl. 2, fig. 1 ; pl. 3 ; pl. 4, fig. 1 ; pl. 5, figs. 1*a*, *b*; pl. 6, figs. 3, 4 ; pl. 11, fig. 5 ; pl. 16, fig. 1.

A slightly compressed cranidium in an old collection from, presumably, the

Couches du Landeyran inférieures at or near Le Foulon, and preserved as an internal mould, agrees with Thoral's description of the species in all respects save that of size. *N. fourneti* was described from the " Schistes à Gateaux " of the Cabrières district, where the species is relatively abundant and generally attains large dimensions.

Niobella cf. ***lignieresi*** (Bergeron)

(Pl. 15, figs. 2, 4)

1895. *Ogygia lignieresi* Bergeron : 476, pl. 5, fig. 4.
1935*a*. *Niobe lignieresi* (Bergeron) Thoral : 258, pl. 24, figs. 2–4 ; pl. 27, fig. 2.

The Couches du Landeyran inférieures in the northern part of the Landeyran Valley have yielded a number of fragments of *Niobella*, and two of the best preserved may be compared with *N. lignieresi*, though both are notably larger than the single specimen figured by Bergeron. A cranidium (Pl. 15, fig. 2) from locality $\lambda 4$ shows a pronounced, almost transverse depression just behind centre of the glabella, and although this has undoubtedly been exaggerated by crushing, the holotype (Bergeron 1895, pl. 5, fig. 4) shows traces of a similar structure. The conspicuous, anastomosing ridges forming a Bertillon pattern on the cranidium from the Landeyran Valley were not mentioned by Bergeron, but he pointed out, in describing the lack of glabellar lobation, that the test of the holotype was not preserved. The pygidium from locality $\lambda 5$ now figured has a relatively narrow axis with six well-defined axial rings and traces of another four, whilst the side-lobes have three sharply delimited pairs of ribs plus at least another two less obvious pairs. According to Bergeron the corresponding figures for the smaller holotype of *N. lignieresi* are eight rings and six pairs of ribs, but Thoral (1935*a* : 259) noted larger specimens of the species which differed from the holotype only in small details, and drew attention to one pygidium with seven axial rings and room for at least another three. The figured pygidium has parts of the surface ornamented with a pattern of raised ridges generally similar to that of the cranidium.

Although Bergeron's holotype was localized merely as " environs de St.-Chinian " he stated that the species occurred fairly frequently in the Montagne Noire, and later Thoral deduced that the specimen derived from the topmost Tremadoc Series of the district, at which horizon he had confirmed it. Additional, better-preserved material is needed before it can be confirmed that Bergeron's species is truly represented in the Couches du Landeyran inférieures. No specimens of *Niobella* have yet been found higher than this horizon in the Landeyran Valley–Le Foulon district.

A fragmentary cranidium from locality $\lambda 2$ is figured here as a latex cast (Pl. 15, fig. 3) and referred tentatively to *Niobella*. Its surface bears a conspicuous ornamentation of raised ridges similar to that on the cranidium illustrated (Pl. 15, fig. 2) as *Niobella* cf. *lignieresi*. The anterior border appears to be slightly thickened, but may have been exaggerated by crushing, whilst the anterior branches of the facial suture are strongly divergent at first, meeting frontally in a blunt point. The facial suture compares with that of *Niobella fourneti* rather than *N. lignieresi*, but the pointed front of the cranidium is lacking in both these species and is more suggestive of the Tremadoc forms *N. obsoleta* Linnarsson sp. (see Tjernvik 1956 : 229) and *N. homfrayi smithi* Stubblefield (*in* Smith 1933 : 368).

Subfamily **OGYGIOCARIDINAE** Raymond 1937

Genus ***OGYGIOCARIS*** Angelin 1854

Ogygiocaris sp.

(Pl. 17, fig. 16)

Figured specimen. Brit. Mus. (Nat. Hist.) It.256.

Locality and horizon. $\lambda 32$, about 240 metres south-west of Le Foulon, in the Couches du Landeyran inférieures.

Description. A single incomplete pygidium is the only specimen collected which may reasonably be assigned to this genus. Most of the right, and part of the left, side-lobe as well as the posterior half of the axis are preserved, and the estimated length and maximum breadth of the entire pygidium are 30 mm. and 47 mm. respectively. Although it is now slightly compressed the axis must originally have been narrow, its length four-fifths that of the pygidium. The posterior half of the axis is only gently convergent backwards, bounded by well-defined axial furrows and ends in a sub-rounded tip which stands well above the side-lobes. The hindmost 6 mm. or thereabouts of the axis are smooth, preceded by only a few traces of ring furrows. The frontal margin of the pygidium arches gently back to sub-rounded anterolateral angles behind which convex lateral margins converge to the broad tip which has a shallow (*sag.*), but nevertheless conspicuous, median indentation. The thin test has been replaced by limonitic material, some of which is exfoliated to reveal a broad doublure, its ventral surface carrying terrace-lines sub-parallel to the margin and its inner limit defined posteriorly by the tip of the axis. The right side-lobe carries seven unfurrowed pleural ribs, including apparently the anterior half-rib, of flattened appearance which extend abaxially back as far as the inner margin of the doublure, leaving a broad, almost flat border. Each rib is convex forwards in plan and subangular at about its centre, outside of which it turns backwards more strongly. In profile the ribs are asymmetrical, each with the anterior margin bevelled forwards to the steeper posterior margin of the preceding rib. The ribs are thus separated by broad (*exsag.*), shallow, pleural furrows which are fairly distinct until just beyond the margin of the doublure, where they then form barely discernible depressions which, in the case of at least the first two furrows, can be traced almost to the margin.

Discussion. The type-species of *Ogygiocaris*, *O. dilatata* (Brünnich) from Stages 4aα and 4aβ of southern Norway, has been discussed and redescribed by Henningsmoen (1960 : 217). According to him the most characteristic feature of *Ogygiocaris* is the pygidium, and he sought to restrict the genus to species which possess a wavy inner margin of the doublure and a similar paradoublural line on the dorsal test. Such an interpretation would mean excluding from *Ogygiocaris* all species hitherto referred to the genus which have been found outside Scandinavia, for example in Argentina and the Montagne Noire. More recently, however, Whittard (1964 : 231–245) has described and illustrated several species of *Ogygiocaris* from the Ordovician of the Shelve Inlier and has demonstrated that the features noted by Henningsmoen are not of generic significance. Accordingly it is preferred here to follow Jaanusson (*in* Moore 1959 : O 352) in regarding *Ogygiocaris* as a widely distributed Lower and Middle Ordovician genus found in Argentina, Europe and Scandinavia.

The single specimen from near Le Foulon is insufficient for a reliable comparison with other species of *Ogygiocaris*, but appears to have the pleural ribs turned backwards more sharply than do any of the forms illustrated by Henningsmoen (1960). It is easily distinguished from *Ogygiocaris? plana* and *O.? inflexicostata*, both from the Cabrières district (Thoral 1946 : 86, 89). The pygidium of the former species is broader and smoother, whilst that of the latter is broader with conspicuously strong, straight ribs, and I would agree with Henningsmoen (1960 : 214) that they should probably be excluded from *Ogygiocaris*. The pygidium of *O. araiorhachis* Harrington & Leanza (1957 : 157) is shorter and more rounded than the specimen now figured and has an entire, curved tip, whilst the pleural ribs, although about the same in number, are flatter and less curved backwards.

Of the species described and figured by Whittard (1964), *Ogygiocaris selwyni* (Salter) from the Lower Arenig has a pygidium which differs from our specimen in having a large concave border and more convergent lateral margins, whilst the tip, although blunt, lacks a median indentation. *O. seavilli* Whittard (1964 : 241), from the Lower Llanvirn Series, has a type of ribbing reminiscent of the Le Foulon pygidium but possesses several more ribs and a well-segmented axis.

Family **TAIHUNGSHANIIDAE** Sun 1931

Genus ***TAIHUNGSHANIA*** Sun 1931

1935*a*. *Miquelina* Thoral : 253.

Taihungshania landayranensis (Thoral)

(Pl. 16, figs. 1, 7)

1935*a*. *Miquelina miqueli* (Bergeron) var. *landayranensis* Thoral : 257, pl. 21, figs. 5–7.

Although described by Thoral as a variety of the better-known and more abundant *T. miqueli* (Bergeron), *T. landayranensis* seems sufficiently distinct for specific recognition and has been found only in the Schistes de Setso. The pygidium of *T. miqueli*, a typical specimen of which is figured here for comparison (see Pl. 16, figs. 3, 4), is longer and narrower than that of *T. landayranensis*, and the posterior margin is semi-elliptical as opposed to broadly rounded. In each case the pair of border spines is formed by extensions of the third pygidial pleurae, but those of *T. landayranensis* are notably longer, extending backwards beyond the tip of the pygidium.

The pygidial axis of *T. miqueli* is longer and narrower with more axial rings, and the side-lobes are well segmented carrying twelve to thirteen ribs in addition to the anterior half-rib, whilst those of *T. landayranensis* do not have more than seven or eight ribs.

A single specimen of *Taihungshania* from the Couches du Landeyran supérieures at locality λ19 near the southern end of the Landeyran Valley, is the only record of the genus from the higher beds of the Ordovician succession in this district. It comprises a slightly compressed cranidium (Pl. 16, figs. 6, 8) which, as far as can be judged, differs from that of *T. miqueli* in having slightly smaller eyes placed closer to the glabella and a little farther forwards, as well as less divergent anterior branches of the facial suture. Sheng (1958 : 192–197) has described and illustrated from the Arenig and Llanvirn Series of south-west China a number of *Taihungshania* species, including *T. miqueli*, but none appears identical with the Landeyran Valley specimen.

Family **NILEIDAE** Angelin 1854

Genus ***SYMPHYSURUS*** Goldfuss 1843

Symphysurus sabulosus sp. nov.

(Pl. 18, figs. 4–7)

Diagnosis. Glabella subparallelsided posteriorly, expanding forwards so that basal breadth is two-thirds that of broadly rounded frontal glabellar lobe. Length and frontal breadth of glabella about equal. Occipital ring poorly defined, uniformly broad (*sag.*), curved forwards abaxially ; occipital furrow shallow, becoming obsolete near axial furrows. Anterior border and preglabellar field not developed. Eyes sited slightly in front of centre of glabella and only short distance from axial furrows.

Holotype. Brit. Mus. (Nat. Hist.) In.57729 (Pl. 18, figs. 4, 5, 7).

Paratype. In.57730 (Pl. 18, fig. 6).

Locality and horizon. Locality λ7, about 480 metres south-west of Upper Bridge, in the northern part of the Landeyran Valley. The horizon is in flaggy calcareous sandstones, accompanied by slickensided shales, forming part of the Couches du Foulon.

Description. The species is known from only two incomplete, isolated cranidia preserved as internal moulds. The glabella is slightly more convex transversely than the adjacent parts of the cranidium, and becomes more strongly declined from back to front. In plan the sides of the glabella diverge forwards gently for half their length and then turn outwards more strongly to the rounded anterolateral angles, where they meet the broadly arched frontal margin. The projected length and frontal breadth are approximately equal, and about one and a half times the basal breadth. No glabellar furrows are discernible. The occipital ring is poorly differentiated, parallel-sided, curving forwards a little abaxially where the ends merge with the posterolateral portions of the glabella. The occipital furrow is represented by a shallow, curved groove, developed over only the median two-thirds of the basal glabellar breadth. Though imperfectly known the pleuroccipital segment is narrow (*exsag.*), delimited by a sharply incised pleuroccipital furrow which is set behind the line of the occipital furrow (see Pl. 18, fig. 7). The axial furrows are broad, moderately deep, becoming shallower frontally, where they curve inwards slightly. There is no trace of a preglabellar field or anterior border, and the frontal margin of the glabella has the appearance of a sutural boundary. The palpebral lobes are unfurrowed, convex in plan, longitudinally just outside the line of the outer margins of the frontal glabellar lobe, and slightly in front of the glabellar centre. The anterior parts of the fixigenae are small and narrow, with the anterior branches of the facial suture slightly convergent forwards. The posterior parts of the fixigenae are set higher than the palpebral lobes and decline abaxially, particularly over their outer halves. The posterior branches of the facial suture curve outwards and strongly backwards from the eyes to the posterior cephalic margin, the basal projected breadth of each fixigena being about two-thirds that of the glabella.

Discussion. The type species of the genus, *Symphysurus palpebrosus* (Dalman) from the Middle Ordovician of Sweden, re-illustrated by Jaanusson (*in* Moore 1959, fig. 267–268), has a broader glabella, larger eyes and smaller fixigenae than *S. sabulosus*, and there is no trace of the occipital furrow. The well-known Scandinavian *S. angustatus* (Sars & Boeck), abundant in both the Tremadoc and early Arenig Series according to Tjernvik (1956 : 211), has a glabella which, although slightly narrower than that of *S. palpebrosus*, is broader than in the new species, though Brøgger's illustrations (1882, pl. 3, figs. 9, 10) suggest a certain amount of variation. The species most like *S. sabulosus* is that described by Brøgger (1882 : 58, pl. 1, figs. 1, 2) as *S. incipiens* from the Tremadoc Series of Norway. The latter has a glabella which, although broader basally than that of the French species, is nevertheless generally narrower and more expanded frontally than in other forms, whilst the posterior portions of the fixigenae of *S. incipiens* are almost comparable in size with those of *S. sabulosus*, but the eyes are larger.

Symphysurus has been found abundantly in the topmost Tremadoc Series of the Montagne Noire, where the species originally described by Bergeron (1895 : 478) as *Aeglina sicardi* was regarded by Thoral (1935*a* : 269) as a variety of *Symphysurus angustatus*. Bergeron's species, like most of the other forms of *Symphysurus*, has a broader, less expanded glabella and larger eyes than *S. sabulosus*.

Family **ODONTOPLEURIDAE** Burmeister 1843

Subfamily **SELENOPELTINAE** Hawle & Corda 1847

Genus ***SELENOPELTIS*** Hawle & Corda 1847

1847. *Polyeres* Rouault : 320 (see below).

It has recently been pointed out (Dean 1964) that *Polyeres* antedates *Selenopeltis* by several months, and that it can no longer be abandoned on the grounds of its being a junior subjective synonym of that genus, as has sometimes been alleged. Topotype material of the type-species, *Polyeres dufrenoyi* Rouault 1847, from the

Ordovician of Riadan, Brittany, leaves no doubt of the identity of the two genera. However, unlike the genus *Prionocheilus* Rouault 1847, discussed earlier in this paper, *Polyeres* was inadequately defined, no specimens have ever been illustrated, and the name has not been employed by systematists. For these reasons I propose here to reject *Polyeres* and retain the later, but well defined and illustrated, *Selenopeltis*.

In redefining both *Selenopeltis* and the Subfamily Selenopeltinae Whittington (1956 : 279 ; *in* Moore 1959 : O 508) stated that the occipital ring is short (*sag.*) with a single median tubercle. His description applies only to the type-species *Selenopeltis inermis* (Beyrich 1846) [=*Selenopeltis buchi* (Barrande 1846)], and in the present account it is preferred to modify this diagnosis of the genus so as to include the new species described below, in which there is a pair of small occipital spines, together with a small median tubercle, on a relatively long pseudoccipital ring composed of the normal occipital ring fused with the posterior part of the median body of the glabella. I prefer to follow Whittard's (1961 : 198) recognition of the priority of Beyrich's specific name, in spite of Vaněk's argument (1965 : 30) to the contrary.

Selenopeltis binodosus sp. nov.

(Pl. 20, figs. 4, 7, 8)

Diagnosis. Species of *Selenopeltis* in which posterior axial portion of cephalon is unusually long, consisting of occipital ring fused with transverse, convex band typically developed in this genus as a discrete structure traversing hindmost part of glabella. Third glabellar lobes large, divided into three parts by faint, transverse furrows, each posterior third so-formed being, in turn, divided into two by short, longitudinal furrow.

Holotype. Brit. Mus. (Nat. Hist.) It.180.

Locality and horizon. Locality $\lambda 33$ at the hillside section 250 metres south-west of Le Foulon. The horizon is in the Couches du Landeyran inférieures.

Description. The species is founded on a single incomplete, but distinctive, cranidium which is of depressed form and only slightly convex both longitudinally and transversely. The glabella is almost one and a half times as broad as long, nearly parallel-sided over its posterior half but narrowing a little frontally to just over half the basal breadth, with the anterolateral margins broadly rounded. There are three pairs of glabellar lobes, increasing markedly in size from first to third. The inner parts of the glabellar furrows do not end in-line, and the median band, the posterior half of which occupies two-fifths of the maximum glabellar breadth, narrows slightly from the second glabellar furrows. The third glabellar lobes are large, longitudinally subrectangular in plan, and of complex form. Each is divided into three parts, the first little more than half the size of each of the others, by two faint, transverse furrows. The first, or anterior part stands very slightly higher than the second, and appears to be defined by an abaxial bifurcation of the third glabellar furrow, particularly at its inner end. In plan this part of the lobe narrows slightly towards the sagittal line and expands a little in the reverse direction, ending with a small lateral projection beyond the margin of the glabella. The median portion of the third glabellar lobe is flattened, subrectangular in plan, and its abaxial margin coincides with that of the rest of the glabella. The posterior portion, like the anterior one, is again slightly raised and its posterior margin is expanded backwards to form two small lobes. The inner lobe is slightly the larger and the two are separated by a shallow longitudinal furrow such as has been described from the corresponding part of the glabella of *Selenopeltis inermis* (Beyrich) by Whittington (1956 : 279 ; *in* Moore 1959 : O 508–509). The shallow furrows between the median and posterior thirds of the basal glabellar lobes are continued adaxially to form a deeper, broad (*sag.*) furrow traversing the median band of the glabella and gently concave forwards in plan. At first sight it would appear that the large structure immediately behind this furrow is nothing more than an extraordinarily large occipital ring. However, the furrow in question has its counterpart in *Selenopeltis inermis*, where it serves to delimit a basal portion of the median band of the glabella, and it appears that there is present what might be termed a pseudoccipital ring, composed of the normal occipital ring fused anteriorly with the posterior part of the glabella and bounded frontally by a pseudoccipital furrow. The maximum length of the pseudoccipital ring is equal to almost two-fifths of the distance between the pseudoccipital furrow and the front of the glabella. In plan it has curved lateral margins, extending forwards to the pseudoccipital furrow, and expands in breadth posteriorly. The dorsal surface is moderately inclined backwards, and the posterolateral margins are produced to form a pair of short, blunt, occipital spines, directed upwards and back. The anterior half of the pseudoccipital ring carries a trace of a low median tubercle. The second glabellar lobes expand a little in breadth (*exsag.*) towards the axial furrows and are separated from the median band by broad (*tr.*), shallow grooves. The outer halves of the third glabellar furrows are shallow and widely divergent forwards towards the axial furrows, but the adaxial portions are deep and arch backwards, ending opposite the mid-points of the third glabellar lobes. The second glabellar furrows are more gently curved back but uniformly deep, and widen (*exsag.*) a little adaxially. The first glabellar lobes are poorly defined, subrectangular in plan with their long axes widely divergent forwards, and bounded frontally by " perched " first glabellar furrows which do not reach the axial furrows. The axial furrows are shallow and poorly defined, whilst the fixigenae stand higher than the glabella at their apices, opposite the third glabellar lobes. They attain their maximum breadth here, about two-thirds that of the third glabellar lobes, but become narrower forwards, curve slightly inwards and end opposite the first glabellar lobes or the second glabellar furrows. Outside the fixigenae is a pair of slightly narrower ocular ridges, bounded adaxially by well-developed furrows which end anteriorly in-line with the small frontal glabellar lobe, from which they are separated by only the shallow frontal portions of the axial furrows. What remains of the anterior border forms a small, narrow (*sag.*) rim, its frontal margin transversely straight, truncated laterally by the incompletely-known anterior branches of the facial suture. Only traces of the palpebral lobes remain, sited opposite the anterior two-thirds of the third glabellar lobes. The rest of the cranidium is not known.

A single incomplete thoracic pleura (see Pl. 21, fig. 6) was found at the type locality of *Selenopeltis binodosus* and shows the characters of the genus, as far as can be judged. The anterior pleural ridge is weakly developed but the anterior pleural spine is not preserved. The posterior pleural ridge curves gently forwards and outwards, and then more strongly backwards, being produced posterolaterally to form an elongated posterior pleural spine. Two conjoined thoracic segments of *Selenopeltis* from the Boutoury district are in an old collection at the University of Montpellier. They provide the only other evidence for the genus in the Montagne Noire, and may well belong to *S. binodosus*.

Discussion. Previously the earliest-known representative of *Selenopeltis* was *S. inermis macrophthalmus* (Klouček), described originally from the Šárka Beds (Llanvirn) of Bohemia (Klouček 1916 : 7 ; Prantl & Přibyl 1949 : 177) and since then found at a similar horizon in South Wales as well as in the Arenig and Llanvirn rocks of the Shelve Inlier (Whittard 1961 : 199). This trilobite differs from *Selenopeltis binodosus* in having a broader glabella and larger fixigenae which are less distinctly separated from the glabellar lobes, and almost coalesce with the anterior halves of the second lobes. More striking differences are found in the posterior third of the glabella and the occipital ring, a region of the exoskeleton which has been described by Whittington (1956 : 279 ; *in* Moore 1959 : O 508) who showed that in the type species *Selenopeltis inermis* (Beyrich) [=*S. buchi* (Barrande)] the hindmost portion of the median lobe of the glabella was traversed by a shallow furrow. His illustrations show the outer ends of this furrow to be sited opposite a pair of transverse furrows crossing the third glabellar lobes, and it is only behind these furrows that the third lobes are subdivided by a pair of shallow, longitudinal furrows. The transverse furrow on the median glabellar lobe is not apparent in the illustrations of Prantl & Přibyl (1949 : 175), nor in those of Barrande (1852, pl. 36, figs. 1, 8, 9 ; pl. 37, fig. 25). By analogy with Whittington's description the front of the apparent occipital ring (here pseudoccipital ring) of *Selenopeltis binodosus* must therefore correspond to the transverse furrow in front of the occipital furrow of *S. inermis*, so that a normal occipital furrow is not developed in the French species. Alternatively one could interpret the anterior of the two pairs of transverse furrows crossing the third glabellar lobes of *S. binodosus* as marking the position of the furrow, here obsolete, traversing the glabella. Against this argument, it must be pointed out that the median thirds of the third glabellar lobes carry no traces of longitudinal furrows. The position would probably be clarified if further material were available, but the present interpretation at least attempts an explanation of the extraordinarily long occipital ring of *S. binodosus*.

It is interesting that both Prantl & Přibyl (1949 : 173) and Whittington (1956 : 280) have commented on the affinities of *Selenopeltis* with the Subfamily Miraspidinae. The genus *Miraspis* has paired spines at the ends of the occipital ring, together with a median tubercle on the posterior part of the median band of the glabella. All these structures have their counterparts in *Selenopeltis binodosus*, but paired occipital spines are unknown in *S. inermis*.

The Breton species *Polyeres dufrenoyi* Rouault 1847 is in need of redescription but is obviously related to *Selenopeltis inermis*, as was appreciated by Barrande. A topotype in the British Museum (Natural History), no. I.15373, is distorted but the pygidium, with its relatively coarse ornamentation, resembles that of *Selenopeltis inermis inermis* rather than *S. inermis macrophthalmus*.

Family **OTARIONIDAE** R. & E. Richter 1926

Genus ***OTARION*** Zenker 1833

Otarion insolitum sp. nov.

(Pl. 19, figs. 11, 13, 14)

Diagnosis. Glabella subtrapezoidal in plan, broader than long, with pair basal glabellar lobes. Deep, broad, continuous furrow circumscribes glabella and straight sides converge forwards to almost straight anterior margin. Eyes positioned just behind line through centre of glabella. Preglabellar field well developed, with length more than one-third that of glabella, bounded frontally by low, narrow (*sag.*) anterior border.

Holotype. Brit. Mus. (Nat. Hist.) In.57452.

Locality and horizon. Locality $\lambda 19$ near the southern end of the Landeyran Valley. The horizon is in the Couches du Landeyran supérieures.

Description. The species is known from only a single small cranidium, a little less than twice as broad as long. Its convexity is only moderate, both longitudinally and transversely, but both this and the proportions may have been altered a little by compression. The length of the glabella is about three-quarters of its basal breadth, whilst the glabellar outline is roughly trapezoidal, with its frontal margin only very slightly convex forwards. There is one pair of basal glabellar lobes, subcircular in plan, about one-third the glabellar length, circumscribed, and separated from the remainder of the glabella, by deep, broad furrows. The sides of the glabella are almost straight, particularly in front of the basal lobes, and converge forwards at about 40° to the rounded anterolateral angles of the frontal glabellar lobe. The frontal breadth of the glabella is half the basal breadth. The axial furrows are straight, deep, and apparently uniformly broad. The slight indentation of the right axial furrow by the basal glabellar lobe is probably mechanical in origin. The axial furrows turn through almost 70° at the anterolateral angles of the glabella and are confluent with the equally broad (*sag.*) preglabellar furrow. The preglabellar field is well developed, its length (*sag.*) equal to between one-third and one-half that of the glabella. It is moderately declined forwards where it meets the narrow (*sag.*), upturned, rim-like anterior border at a poorly-defined anterior border furrow. The occipital ring is short (about one-fifth the glabellar length), convex, separated from the glabella by a transversely straight occipital furrow which is indented by the basal glabellar lobes. The pleuroccipital furrow is mostly transversely straight, curving back a little distally. The pleuroccipital segment is narrow (*exsag.*) just outside the axial furrows and becomes slightly wider distally. The palpebral lobes are smooth, rounded in plan, sited opposite a point just behind centre of the glabella. The anterior branches of the facial suture follow a sigmoidal course, converging forwards at first until almost opposite the preglabellar furrow ; they then diverge as far as the anterior border furrow, when they again converge, this time more sharply so as to intersect the cephalic margin at an acute angle. The posterior branches are less well preserved but appear to be typical for the genus, that is to say they are almost straight, running backwards and outwards to cut the posterior cephalic margin. The surface of the holotype shows no ornamentation, probably owing to its preservation as an internal mould. The remainder of the exoskeleton is unknown.

Discussion. *Otarion insolitum* is probably the oldest-known representative of the genus, and may be distinguished from younger Ordovician species by its more angular, convergent glabellar outline and longer preglabellar field. Cooper (1930 : 377–378), when describing *Otarion* [*Cyphaspis*] *minimum* from the Upper Ordovician of Quebec, drew attention to the " extremely long frontal border " of that species, presumably referring to the combined preglabellar field and broad (*sag.*) anterior border. The preglabellar field of *O. insolitum* is still longer (*sag.*) than that of *O. minimum* whilst the anterior border is much narrower, but the combined length of these structures is greater than that of the Canadian species. Previously *Otarion* was unknown from pre-Middle Ordovician rocks, and *O. insolitum* is of particular interest in illustrating the small changes undergone by the cephalon of the genus during a remarkably long span of time.

Family **PROETIDAE** Salter, 1864

Proetid gen. et sp. indet.

(Pl. 15, figs. 1, 7)

Figured specimen. A cranidium, the only known specimen, in the collections of the University of Montpellier.

Locality and horizon. The specimen is labelled merely as " Le Foulon " and probably comes from the outcrops south-west of that building (see Text-fig. 5). The horizon is almost certainly the Couches du Landeyran inférieures.

Description. The cranidium is apparently only slightly convex, though this has probably been exaggerated by crushing, judging from the fractures of the test. The occipital furrow is barely discernible, so that the glabella and occipital ring are almost continuous. There are no glabellar furrows and the combined glabella and occipital ring are subtriangular in plan, bounded by straight, shallow, axial furrows which converge forwards at about 35° and are continuous with a preglabellar furrow of similar depth which circumscribes the narrowly rounded, frontal glabellar lobe.

The anterior border is flattened, brim-like, becoming a little narrower (*sag.*) abaxially but with a median breadth equal to one-seventh of the length of the cranidium. The anterior border and glabella are separated by a gently declined preglabellar field which is narrowest medially, where its breadth equals that of the anterior border, but broader abaxially to merge with the large frontal halves of the fixigenae. The palpebral lobes are only slightly convex and situated relatively far from the glabella ; they converge forwards, parallel to the axial furrows, and carry faint palpebral furrows. The length of the palpebral lobes is one-fifth that of the cranidium, and their anterior ends are situated a little in front of a line through the centre of the glabella. The anterior branches of the facial suture diverge at approximately 40° and are straight as far as the anterior border, where they curve inwards through about 60°, run at an acute angle to the cephalic margin and meet frontally in a broad arc. The posterior branches curve outwards and back so as to cut the posterior margin well outside the line of the palpebral lobes. The pleuroccipital furrow is about level with or slightly behind the conjectured position of the occipital furrow, whilst the posterior margin of the pleuroccipital segment is set slightly in front of that of the occipital ring. Markedly narrow (*exsag.*) immediately outside the axial furrows, the pleuroccipital segment broadens a little abaxially. As far as can be judged, the whole of the cranidial test is smooth.

Discussion. The history of the proetid trilobites during the Ordovician is poorly documented, and undoubted representatives have not been described prior to the Middle Ordovician. No comparable species have been illustrated, and additional material would probably require the erection of a new genus. An unusual feature is the manner in which the glabella and occipital ring are united, but the anterior border, preglabellar field and form of the facial suture resemble those of the proetids, whilst the triangular glabellar outline is not uncommon, as for example in *Clypoproetus* Begg, from the Upper Ordovician, and numerous other, later genera.

Family **REMOPLEURIDIDAE** Hawle & Corda 1847

Subfamily **RICHARDSONELLINAE** Raymond 1924

Genus ***APATOKEPHALUS*** Brögger 1896

Apatokephalus incisus sp. nov.

(Pl. 20, figs. 1–3, 5, 6, 9 ; Pl. 21, figs. 1–4, 7)

Diagnosis. *Apatokephalus* with three pairs straight glabellar furrows, all sited behind large, broad glabellar tongue. First and second pairs meet palpebral furrows ; third pair developed only adaxially and does not traverse glabella. Preglabellar field narrow (*sag.*). Anterior border furrow contains series of pits. Long, curved, librigenal spines developed well forwards, opposite mid-points of palpebral lobes and outside pair of large notches in posterior margin of librigenae. Pygidium with small triangular axis and three axial rings. Pleural lobes end in three well-defined pairs of pleural spines, with diminutive fourth pair. First and second pairs spines end in-line, remaining spines stepped forwards successively.

Holotype. Brit. Mus. (Nat. Hist.) It.176 (Pl. 20, figs. 1, 2).

Paratypes. In.57422 (Pl. 21, figs. 3, 7); It.177 (Pl. 20, fig. 3); It.179 (Pl. 20, fig. 6); It.182 (Pl. 21, fig. 2); It.183 (Pl. 20, fig. 9; Pl. 21, fig. 4); It.287 (Pl. 20, fig. 5).

Localities and horizon. The species was found most commonly at the hillside section 250 metres south-west of Le Foulon, where it was collected from localities $\lambda 30$, $\lambda 31$ and $\lambda 33$, particularly the last. In the Landeyran Valley *Apatokephalus incisus* has been found at two localities, both near the northern end of the valley. The better-preserved and more abundant material is from locality $\lambda 2$, but a slightly distorted cranidium with attached thorax was found at locality $\lambda 4$. In the present area all the known specimens are from the Couches du Landeyran inférieures, and the species occurs also in the Boutoury district, probably at the same level.

Description. The cephalic outline is rounded, sub-semicircular frontally, the length, including librigenal spines, being almost one-and-a-sixth times the maximum breadth as measured across the spines, well behind the line of the occipital ring. The glabella is known only from specimens which have been slightly compressed so that accurate proportions are difficult to determine, but the median projected length is probably about five-sixths of the maximum breadth. The posterior portion of the glabella, occupying approximately two-thirds of the projected length, is transversely subellipitical in outline, but the anterior portion extends forwards to form a glabellar tongue, the basal breadth of which is almost half the maximum breadth of the glabella. Three pairs of unequal glabellar lobes are present. The first pair are the smallest, rectangular in plan and bounded frontally by short (*tr.*) first glabellar furrows which resemble straight, narrow incisions and run inwards and backwards at an angle of 50° to the sagittal line. At their outer ends the first glabellar furrows intersect the forward extension of the palpebral furrows and indicate the base of the glabellar tongue. The second glabellar furrows are narrow, straight, parallel to the first pair but more than twice as long (*tr.*), and extend inwards a little farther; they, too, cut the palpebral furrows. The third glabellar furrows do not extend so far abaxially as the second furrows and are only about half their length. Consequently the second and third glabellar lobes are developed separately for only about one-third their length and fuse together abaxially, the third lobes being slightly the wider (*exsag.*), with their anterolateral margins slightly expanded. The large dimensions of the glabellar tongue have already been noted. Here it corresponds also to the frontal glabellar lobe, though this is not always so in remopleuridids, as the glabellar tongue may include also the first glabellar lobes. In specimens which have been dorsally compressed the glabellar tongue sometimes appears longer than was actually the case, and the manner in which it was turned down frontally is not now obvious. The tongue expands forwards only slightly and its anterior margin is moderately convex, bounded by a shallow preglabellar furrow. Immediately in front the preglabellar field is narrow (*sag.*) medially but broadens abaxially; it is separated from the anterior border by a broad, shallow, anterior border furrow which can sometimes be seen to contain a number of pits, such as are known from other genera of the Richardsonellinae. The maximum number of pits found preserved in any one specimen is eight or nine, but the original number must have been greater, probably nearer fifteen in the largest cephala. The anterior border has a frontal breadth (*sag.*) rather more than twice that of the preglabellar field, and is continuous postero-laterally with the lateral borders. The dorsal surface of the anterior border is nearly flat and must originally have been in the same plane as the posterior portion of the glabella, that is to say almost at right-angles to the strongly declined glabellar tongue, though this relationship is generally obscured by crushing in an argillaceous matrix. The librigenae are narrow with raised, ridge-like, lateral borders marked off by broad lateral border furrows forming continuations of the anterior border furrow. Their lateral margins are curved and they are produced backwards to form a pair of long librigenal spines which arise from points level with the mid-points of the palpebral lobes and arch outwards slightly until behind the line of the occipital ring, when they become gently convergent, ending in slender points. The inner margins of the librigenal spines are separated from the hindmost parts of the librigenae by large, triangular notches, the adaxial margins of which are straight, converging backwards to meet the posterior cephalic margin outside the lines of the palpebral lobes. The visual surfaces of the eyes have not been found, but their lower boundaries were circumscribed by narrow eye platforms. The occipital ring is trapezoidal in plan, transversely parallelsided with the straight lateral margins running backwards and slightly outwards and bounded by deep axial furrows, and is separated from the glabella by a uniformly deep occipital furrow. The palpebral lobes are large, elongated, semi-elliptical in outline with flattened dorsal surface. They are uniformly narrow for most of their length but the hindmost portions become broader opposite the inner ends of the third glabellar furrows, at the same time flexing more sharply inwards and ending with their posterior margins opposite the occipital furrow. The frontal part of each palpebral lobe continues forwards as a narrow rim, running below and alongside the glabellar tongue and merging frontally with the fixigena. The palpebral furrows are moderately deep and broad along the anterior two-thirds of the palpebral lobes but become deeper and narrower posteriorly, where they follow a sinuous course and converge backwards to join the outer ends of the occipital furrow. Frontally they become narrower and shallower, and run into the furrows flanking the glabellar tongue, which in turn coalesce with the preglabellar furrow. From each axial furrow the pleuroccipital segment extends outwards for only a short distance, approximately equal to two-thirds of the breadth (*tr.*) of the occipital ring. It widens (*exsag.*) abaxially for about two-thirds of its length (*tr.*), then narrows more sharply to a blunt point, and carries a broad (*exsag.*) pleuroccipital furrow which is transversely straight in direction and set in-line with the hindmost part of the occipital ring. The anterior branches of the facial suture are long and follow a markedly flexuous path; they at first curve forwards only a little way from the front ends of the eyes, then turn outwards and back, and run subparallel to the lateral border furrows until slightly beyond the line of the palpebral lobes, where they flex forwards sharply through almost 180°, cutting the anterior border obliquely and finally converging frontally below it.

The thorax has not been found completely preserved but comprises at least nine segments of generalized remopleuridid aspect. The axis is moderately convex, fairly broad (about half the thoracic breadth), and is delimited by deep, narrow axial furrows. The axial rings are rectangular in plan, the breadth (*sag.*) between one-quarter and one-fifth of the length (*tr.*). The pleurae are broadly similar to those of *Remopleurides*, that is to say flattened, parallel-sided, directed outwards and slightly backwards from the axial furrows for about half their length and then narrowing sharply to form short, curved pleural spines directed posterolaterally. Broad (*exsag.*) pleural furrows run backwards abaxially from the anterior margins of the pleurae at the axial furrows. The pleural furrows are deep and straight at first but then become fainter and curve backwards, though without reaching the tips of the pleural spines.

The pygidium is of depressed form, slightly more than one-and-a-half times as broad as long, its outline well rounded frontally, except at the axis, and ending in a spinose posterior margin. The axis is small, triangular in plan, with frontal breadth about one-third the maximum breadth of the pygidium. It has straight sides converging backwards at about 55° and marked by narrow, moderately-deep axial furrows which become slightly shallower and less well defined as they meet at the pointed axial tip. There are three axial rings, followed by a triangular terminal piece occupying about, or slightly more than, half the length of the axis. Immediately behind the third axial ring of one specimen (Pl. 21, fig. 4) is a small median node, about one-third the frontal breadth of the terminal piece and almost half its length. This is apparently an original feature but as the corresponding portion of the only other available pygidium is damaged, there is no certainty that it is not the result of crushing. The side lobes are large, wide and flattened, composed of four pairs of pleurae which decline in size from first to fourth, at the same time becoming more strongly arched backwards until the fourth pair are parallel to each other. The first two pleurae end in large, curved, free spines, the length of each being about one third that of the pleura, and the pointed tips end in-line with one another posteriorly. The spines formed by the third pleurae are notably smaller, their tips stepped forwards, whilst the fourth pair of spines is represented by a pair of tiny projections arising from pleurae which are small and scarcely discernible. Each of the first three pleurae is divided into two bands by a deep, broad (*exsag.*), pleural furrow which becomes less distinct towards the tip of the pleural spine. The anterior band is only about half the size of the posterior band.

The hypostoma has not yet been found and the underside of the exoskeleton is poorly known, but the ventral surface of the librigenal spines carries a series of thin, longitudinal, raised ridges. The doublure is well developed on both thorax and pygidium, in the latter case extending inwards almost level with the tip of the axis. The ventral surface of the doublure is ornamented with closely grouped terrace-lines.

The surface of the glabella is covered with closely-grouped, coarse granules, except at and near the glabellar furrows (see Pl. 21, fig. 3). Similar ornamentation is found on the occipital ring and the axial rings of the thorax, but has not yet been traced on the anterior border, palpebral lobes, thoracic pleurae or pygidium, the test of which is either smooth or very finely granulated.

Discussion. The type-species of *Apatokephalus*, *A. serratus* (Boeck), was described originally from the Ceratopyge Limestone (Tremadoc Series) of the Oslo region, and has been redescribed and illustrated from Scandinavia by a number of authors, particularly Brøgger (1882 : 126, pl. 3, figs. 7, 8), Moberg & Segerberg (1906 : 88, pl. 5, figs. 9, 11) and, more recently, Tjernvik (1956 : 204, pl. 2, figs. 7, 8, text-fig. 32A). A line restoration of the species published by Whittington (*in* Moore 1959 : O 329, fig. 243–2a, b) differs in several respects from that provided by Tjernvik. The latter author's illustration of the librigena shows the genal spine arising from a point well forward of the line of the pleuroccipital furrow, resulting in the formation of a large notch adjacent to the genal spine. Conversely the librigena figured by Whittington shows only a trace of such a notch and the genal spine runs backwards almost from the genal angle. The third glabellar furrows of Whittington's illustration are shown as gently sigmoidal grooves developed only adaxially, with the straight second furrows almost reaching the axial furrows, whilst the first furrows are straight, directed outwards and slightly backwards, ending slightly farther from the axial furrows than do the second furrows. In Tjernvik's restoration the third glabellar furrows are more strongly divergent forwards and extend a little nearer the axial furrows, whilst both the second and first glabellar furrows are straight, running backwards and inwards from the axial furrows. The apparently shorter glabellar tongue of Whittington's illustration could well be accounted for by differences in preservation and relative position of the cephalon. The form of the pygidium is generally similar in both sets of drawings, but whilst Whittington's diagnosis of the genus claims there are only five pairs of pleural spines, according to Tjernvik there are six or seven pairs, numbers which are supported by Brøgger's illustrations of the species (1882, pl. 3, figs. 7, 8). The pygidium of *Apatokephalus incisus* has only four pairs of pleural spines, an unusually small number for the genus, but the importance of this feature should not be overestimated in view of the fact that specimens of *A. serratus* with from five to seven pairs of spines have been illustrated.

"*Apatokephalus serratus* (Sars & Boeck)" as described and illustrated from the Marathon Uplift of Texas by Wilson (1954 : 275, pl. 27, figs. 1, 2, 13) appears to be distinct from the Scandinavian form and to represent a new species, for which the name *Apatokephalus wilsoni* nom. nov. is now proposed. It is particularly characterized by its conspicuously convex, broad, glabellar tongue, notably larger than in other species of the genus, with the palpebral lobes projecting only a relatively short distance beyond the line of its lateral margins. In addition, the anterior border is unusually convex forwards in plan, separated from the well-rounded frontal glabellar lobe by only a narrow (*sag.*) furrow containing a number of pits.

The new species bears a considerable resemblance to *Menoparia*, described from the Garden City Formation of Utah by Ross. The type-species, *Menoparia genalunata* Ross (1951 : 88, pl. 20, figs. 13–24, 28, 29, 34–5), has a pygidium in which the development of pleural lobes and spines is much the same as those of *Apatokephalus incisus* but the axis is much larger and longer. The cephalon of the American form has a facial suture and anterior border like those of *A. incisus*, but the latter species lacks the axial furrows of *M. genalunata*, probably a much more significant feature for generic distinction than the pygidium. For the same reason it is unlikely that *Menoparia? nericiensis* Tjernvik (1956 : 206, pl. 2, fig. 9–11, text-fig. 32B), from the Arenig Series of Sweden, truly represents that genus, and in some respects the species more resembles a genuine *Apatokephalus*. The pygidium of *M.? nericiensis* is broadly similar to that of *Apatokephalus incisus*, differing in having a small postaxial ridge, and third pleural spines which are slightly longer than the first and second pairs. The librigena of the Swedish species has almost no development of a genal notch and the cranidium carries only two pairs of glabellar furrows, but the cephala are otherwise alike in all essential features. The pygidium of *Eorobergia marginalis* (Raymond), the type-species of *Eorobergia* Cooper (1953 : 21, pl. 8, figs. 1–6), from the Middle Ordovician of Tennessee, differs from that of *Apatokephalus incisus* in having the third and fourth pleural spines longer than the first and second pairs, and also, like *Menoparia*, in possessing a conspicuously larger axis. The cephalon of *Eorobergia* is like that of *A. incisus*, particularly in the plan of the palpebral lobes and the disposition of the glabellar furrows, though the first and second pairs are less well defined, but the anterior branches of the facial suture flex outwards only a little way, and consequently the cranidium does not have the large, lateral projections of the anterior border which are so conspicuous a feature of the cranidium in the French species.

One other remopleuridid trilobite has been described from the Arenig Series of the Montagne Noire, namely *Apatocephalus* [*sic*] *brevifrons* Thoral (1935*a* : 293, pl. 19, figs. 5, 6). The species was founded on three syntypes, all cranidia, two of them from a siliceous nodule collected " 400 metres west of Prades-sur-Vernazobre " (a village between Lugné and St. Chinian), the third from an undefined locality near St. Chinian. The original of Thoral's pl. 19, fig. 5, a specimen in the collections of the University of Montpellier, is chosen here as lectotype and a cast of it is refigured (see Pl. 21, fig. 5). Although the glabellar furrows of *A. brevifrons* are in positions generally similar to those of other species of the genus, they are much longer (*tr.*) leaving only a narrow median band, and even this appears to be traversed by a groove connecting the third glabellar furrows. In addition all the glabellar furrows are uniformly and markedly deep, and intersect the palpebral furrows. The glabellar lobes so formed have well-rounded tips which bulge beyond the outer ends of the glabellar furrows, the second lobes being conspicuously clavate in outline. The dorsal surface of the glabella is less flattened than in other species of *Apatokephalus*, the glabellar tongue is unusually small and convergent forwards, and it is likely that additional material of this species would necessitate the erection of a new generic name.

A Norwegian cranidium purporting to be that of *Apatokephalus serratus* was figured by Størmer (1922, pl. 2, fig. 3). The third glabellar furrows of this specimen are apparently confluent across the median band of the glabella and Tjernvik (1956 :

205) has suggested that it probably represents a new species. As described above, such a continuation of the third glabellar furrows may be an original character in *Apatokephalus? brevifrons* Thoral, but similar features have been found in *Apatokephalus incisus* and in this case there can be little doubt that the supposed median portion of the furrow is the result of crushing.

V. RELATIONSHIPS OF THE SHELLY FAUNAS

Some years ago Stubblefield (1939), in discussing the Lower Palaeozoic trilobite faunas of the British Isles, noted that it was possible to delimit certain faunal provinces there. He showed that the Lower and Middle Ordovician faunas of what he called the " Scots–Irish Area " closely resembled those of eastern North America, whilst contemporaneous faunas of the Anglo–Welsh area showed affinities with Bohemia and southern Europe. His observations matched those published later by Spencer (1950) on the corresponding echinoderm (Asterozoan) faunas. Since then Spjeldnaes (1957) has discussed the distribution of Ordovician climatic zones with particular reference to Europe and Scandinavia, equating them in the process with faunal provinces, in a paper which, in some respects, tends to oversimplify the problems by grouping together various deposits of different ages. His map of the " Middle Arenig " province shows the Montagne Noire as one with the south-eastern half of the Iberian Peninsula, forming a " trilobite facies, mudrock in Mediterranean province ", merging to the south with the south-eastern extremity of the " Armorican Quartzite " of western France, the north-western Iberian Peninsula, and extending into North Africa. This region is separated by him from Bohemia. According to Spjeldnaes the Mediterranean Province extended eastwards to Syria, but this appears to be an underestimate and the Arenig faunas suggest an extension at least as far as south-western China.

In a recent review of Ordovician faunal provinces Whittington (1963 : 18–23) noted three as existing during Upper Arenig times, namely a Bathyurid province (covering North America, Greenland, and the Caledonian belt of western Norway, north-west Scotland and western Ireland), an Asaphid province (southern Scandinavia and the Baltic region), and a Calymenid-trinucleid province (comprising Wales, central England, and a belt extending longitudinally south-westwards from Central Europe to Morocco by way of France and the Iberian Peninsula). It is with the last-named province that the faunas of the Montagne Noire, and others in the Mediterranean region, are primarily concerned. Whittington (1963 : 20) believed this province to have been less well defined during Arenig times than in the Llanvirn–Llandeilo, but the present evidence suggests that the general pattern was established at least as early as the lower Arenig. As Whittington noted, the genera *Geragnostus* and *Ampyx* are common to all three provinces, and the former was already widely distributed in Upper Cambrian and Tremadoc faunas.

The faunas described in the present paper refer only to the eastern end of the principal Ordovician outcrops on the southern flanks of the Montagne Noire. To the west the successions around Prades-sur-Vernazobres, St. Chinian, and south of

Coulouma have still to be examined in detail, but there are certainly marked facies changes in that direction, and the sandstones of the Grès à Lingules and Couches du Foulon die out. Similarly the black, graptolitic Schistes de Setso, containing *Taihungshania landayranensis*, may be represented near St. Chinian by mudstones and shales in Thoral's zone of *Taihungshania* [*Miquelina*] *miqueli*, the only other horizon at which the characteristic trilobite genus is at all common in this region. The exact line of demarcation between the Tremadoc and Arenig Series in the St. Chinian district (*s.l.*) is not so sharply defined as might appear from the published accounts, but the strata of late Tremadoc–early Arenig age have yielded, over the years, numbers of siliceous nodules containing trilobites, molluscs and carpoids. This facies, and the included fauna, is closely paralleled by that of the younger Šárka Beds (Llanvirn Series) in the Rokycany district of Bohemia, as well as by the strata of Le Traveusot in Brittany, suggesting a northward extension of the province from Arenig to Llanvirn times. East-north-east of the Landeyran Valley the faunas of all the Couches du Landeyran are well represented in collections from the Boutoury district, just north of Cabrières, whilst the trilobites of the one-time " Schistes à Gateaux " at Cabrières, described by Thoral (1946), suggest at least a partial correlation with the Couches du Landeyran inférieures. The map of this region published by Chazan (1939) did not subdivide the Arenig succession, and there is no indication that the lateral equivalents of the Grès à Lingules are present, but some of the type material of *Taihungshania miqueli*, the index-fossil of the basal Arenig near St. Chinian, was described by Bergeron (1893 : 334) from Boutoury.

The Ordovician stratigraphy and faunas of the Méséta marocaine occidentale (the region south-west of Casablanca) were described by Gigout (1951) who noted their Franco–Bohemian affinities. In a later paper (1956) he revised the stratigraphical position of the strata and divided them as follows : basal quartzites ; two successive shaly series with graptolites suggesting the lower and upper zones of the Arenig Series ; and a shaly, sandy series containing numerous trilobites and the Lower Llanvirn index-fossil *Didymograptus bifidus*. The highest series was followed unconformably by Silurian strata, a state of affairs broadly paralleled in the Montagne Noire, where Arenig strata are followed as a rule by Devonian beds or, in certain areas such as that of Neffiès, some 20 km east-north-east of the Landeyran Valley, by a thin, fragmentary Ordovician succession of alleged Caradoc and Ashgill strata and then an incomplete Silurian sequence. Although the Moroccan species *Neseuretus attenuatus* (Gigout) has not yet been confirmed in the Montagne Noire, as was claimed by Gigout, nevertheless there can be no doubt that certain genera are common to both regions, and the resemblance of Gigout's " *Calymene* aff. *pulchra* " to *Bathycheilus gallicus* was noted earlier. Further evidence of these faunal affinities is provided by Gigout's discovery (1954) in Morocco of the carpoid *Phyllocystis blayaci* Thoral, a species first described from the upper Tremadoc and basal Arenig Series near St. Chinian (Thoral 1935*a* : 104). Gigout has used the fact that the Moroccan specimens are supposed to occur at a slightly later horizon to support his suggestion that *Phyllocystis*, together with certain trilobites from the Montagne Noire, migrated towards Morocco from the north. In fact, the records of species common to both regions appear to be of at least broadly comparable age, namely Lower Arenig (=Extensus Zone). Other Montagne Noire species, or forms close to them, recorded from Morocco are *Niobe fourneti* Thoral and *Plesiomegalaspis graffi* Thoral (see Gigout 1951 : 282–283 ; Van Leckwijck *et al.* 1955 : 15). These two species occur in the Cabrières faunas and, if truly present in North Africa, suggest a large lateral distribution of the appropriate strata or their probable equivalents, the Couches du Landeyran inférieures. More recently Destombes (1963 : 152) has recorded from the Lower Arenig of the Anti-Atlas several trilobite families which occur at the same horizon in the Montagne Noire.

Judging from the published lists of Ordovician trilobites from Bohemia (see, for example, Havlíček *et al.* 1958) there was little connection between that region and Hérault during early Arenig times, the genera common to both including only *Geragnostus* and *Pliomerops* (see earlier). However, one of the most striking features of the Arenig faunas in the Montagne Noire is the large number of genera which probably migrated from there to Bohemia, and are not known from that region prior to the Llanvirn Series. A notable example is the dalmanitid *Ormathops*, previously unrecorded from the Arenig Series but widespread in European Llanvirn strata. *Ormathops borni* (see earlier) of the Landeyran Valley outcrops almost certainly includes the forms listed by both Born (1921) and Thoral (1933 : 148) as *Dalmanites socialis* Barrande, the type-species of *Dalmanitina*. The latter genus is characteristically later in age, and in the Montagne Noire has been recorded, as *Dalmania socialis* var. *grandis* (Barrande) and var. *proaeva* (Emmrich), only from the supposed Caradoc strata of the Grand Glauzy, in the Neffiès district, where it occurs in company with *Cryptolithus grenieri* (Bergeron) and *Kloucekia* [*Dalmania*] *exophtalma* (Dreyfuss 1948), an assemblage having affinities with north-western France. The Arenig *Bathycheilus gallicus* of the Landeyran Valley was followed by *B. perplexus* in the Bohemian Llanvirn, whilst a similar distribution holds good for the more widespread calymenaceids *Colpocoryphe* and *Prionocheilus* as well as the rare nileid *Kodymaspis* (see Prantl & Přibyl 1949*a* : 6), represented in the Arenig by *Platypeltis*? *macrophthalmus* Thoral (1935*a* : 273) and in the Llanvirn by *Illaenus puer* Barrande (1872 : 73).

In north-western France, according to Dangeard (1951 : 42, 46) the Lower Ordovician is represented by the almost unfossiliferous Grès armoricain, and, as in Bohemia, it is not until later that the full effects of the migrations from the Mediterranean region are fully seen. The true " Schistes à Calymènes ", the type development of the so-called " *tristani* fauna ", belong mainly to the *Didymograptus murchisoni* Zone (Phillipot 1950), and although *Neseuretus*, *Colpocoryphe*, *Prionocheilus* and *Selenopeltis* are known from the Arenig of Hérault, they are joined here by *Placoparia*, *Dalmanitina* and asaphids, all of definite Bohemian type and as yet unknown below the Llanvirn. A similar state of affairs exists at about this horizon in Portugal (see Delgado 1908 ; Curtis 1961), where we also find the Bohemian *Bathycheilus perplexus* (Thadeu 1958), as well as in Spain, where the *Neseuretus tristani* fauna is well developed (Born 1918).

The Llanvirn trilobite faunas of the Anglo-Welsh area have remarkably close affinities with those of Bohemia, whilst those of the Arenig Series have several genera in common with the Montagne Noire, for example *Geragnostus*, *Ampyx*, *Neseuretus*, *Selenopeltis* and *Ogygiocaris*. The trinucleid *Myttonia*, though not known outside the area, nevertheless has affinities with *Hanchungolithus* and is placed in the same subfamily. The absence of *Colpocoryphe* is a curious feature of the Anglo–Welsh faunas, but the rare *Platycoryphe* of the Landeyran Arenig is followed by a greater abundance of the genus in the Llanvirn of the Shelve Inlier. The trilobites of both the Arenig and Llanvirn Series in the Anglo–Welsh area occur mostly in argillaceous sediments, and consequently are generally accompanied by large numbers of molluscs, particularly bivalves and gastropods, and phyllopods. They share this character with the corresponding faunas of Bohemia, north-western France, the Iberian Peninsula, the Montagne Noire and North Africa, and certain genera persisted through a long span of geological time with relatively little modification. *Redonia*, described first by Rouault (1851 : 362) from Brittany, is a particularly conspicuous member of the bivalve fauna, whilst the supposed phyllopod *Ribeiria*, founded by Sharpe (*in* Ribeiro 1853 : 157) on Portuguese material, occurs in the Montagne Noire (Thoral 1935*a* : 171) as well as the Shelve Inlier, where it is represented by *R. complanata* (Salter *in* Salter & Etheridge 1881 : 551).

Whittington's record (1953) of *Colpocoryphe* in Florida suggests a possible western limit for the Mediterranean Province, but elsewhere in North America the only genera in common with the Montagne Noire, including *Geragnostus*, *Ampyx* and *Pliomerops*, are members of almost ubiquitous groups. The province probably had a considerable extension eastwards as several species of *Taihungshania*, including *T. miqueli*, have been reported from south-western China (Sheng 1958), together with synhomalonotids and asaphids including *Paramegalaspis*. The resemblance of *Hanchungolithus primitivus* to *H. multiseriatus* from this region was discussed earlier, and the Llanvirn age of the Chinese species suggests that *Hanchungolithus* migrated eastwards from the Montagne Noire, but the manner in which the two regions were connected during early Ordovician times is not yet clear. Trilobites of estimated Llandeilo age from a deep borehole in Syria (Stubblefield *in* Sudbury, 1957) include *Colpocoryphe*, whilst my own unpublished researches show that *Dalmanitina*, *Kloucekia* and the trinucleid genus *Marrolithoides* occur in a Caradoc fauna in south-eastern Turkey, so there is no doubt that some Middle Ordovician faunas were widely distributed in the Mediterranean region, but evidence for the lowest Ordovician strata is not yet available.

VI. REFERENCES

Barrande, J. 1852. *Système silurien du centre de la Bohême. 1ère partie. Recherches paléontologiques, I.* xxx+935 pp., Atlas 51 pls. Prague & Paris.

—— 1872. *Système silurien du centre de la Bohême. 1ère partie. Recherches paléontologiques, I (supplement).* xxx+647 pp., Atlas, 35 pls. Prague & Paris.

Bergeron, J. 1893. Notes paléontologiques. I. Crustacés. *Bull. Soc. géol. Fr.*, Paris, (3) **21** : 333–346, pls. 7, 8.

—— 1895. Notes paléontologiques. Crustacés. *Bull. Soc. géol. Fr.*, Paris, (3) **23** : 465–481, pls., 4. 5.

BÉZIER, T. 1907. *Prionocheilus Verneuili* Rouault, 1847. In *Palaeontologia Universalis*, Paris, **1** : 120, 120a.

BLAYAC, J., MICHEL-LEVY, A., ROQUEFORT, C. & THORAL, M. 1938. Feuille de Bédarieux au 1/80.000e, et notice explicative. 2e édit. *Carte géol. de la France*, **232**.

BORN, A. 1918. Die *Calymene Tristani*-Stufe (mittleres Untersilur) bei Almaden, ihre fauna, Gliederung, und Vertreitung. *Senckenb. natur. Ges.*, Frankfurt a.M., **36** : 309–358, pls. 24–27.

—— 1921. Eine Untersilurfauna aus den Montagnes noires (Centralplateau). *Senckenbergiana*, Frankfurt a.M., **3** : 181–193, 1 fig.

BRØGGER, W. C. 1882. *Die silurischen Etagen 2 und 3 im Kristianiagebiet und auf Eker, ihre Gliederung, Fossilien, Schichtenstörungen und Contact-metamorphosen.* viii+376 pp., 12 pls. Kristiania.

BRONGNIART, A. 1822. *Histoire Naturelle des Crustacés Fossiles, sous les rapports zoologiques et géologiques. Savoir : Les Trilobites.* 66 pp., 4 pls. Paris.

BULMAN, O. M. B. 1958. The sequence of graptolite faunas. *Palaeontology*, London, **1** : 159–173, 3 figs.

CARLES, P. 1895. Compte Rendu de l'Excursion du 17 Juin 1894 à Cessenon et au Foulon. *Bull. Soc. Sci. nat. Béziers*, **17** : 168–175.

CAVET, P. & PILLET, J. 1964. Contribution à l'étude stratigraphique et paléontologique du synclinal d'Ancenis (Massif armoricain). *Bull. Soc. géol. Fr.*, Paris (7) **5** : 318–329, pl. 15.

CHAZAN, W. 1939. Étude de la Région Nord-Ouest de la commune de Cabrières (Hérault). *Bull. Soc. Étud. Sci. Aude*, Carcassonne, **43** : 94–107, 1 map.

COOPER, B. N. 1953. Trilobites from the Lower Champlainian formations of the Appalachian Valley. *Mem. geol. Soc. Amer.*, New York, **55** : 1–69, pls. 1–19.

COOPER, G. A. 1930. New species from the Upper Ordovician of Percé. *In* SCHUCHERT, C. & COOPER, G. A. Upper Ordovician and Lower Devonian stratigraphy and paleontology of Percé, Quebec, Pt. II. *Amer. J. Sci.*, New Haven (5) **20** : 365–392, pls. 4, 5.

CURTIS, M. L. K. 1961. Ordovician trilobites from the Valongo area, Portugal. Cheiruridae, Pliomeridae and Dionididae. *Bol. Soc. geol. Portugal*, Lisboa, **14** : 1–16, pls. 1–8.

DANGEARD, L. 1951. Géologie régionale de la France. 8. La Normandie. *Actual sci ind.*, Paris, **1140** : 1–241.

DEAN, W. T. 1961. The Ordovician trilobite faunas of South Shropshire, II. *Bull. Brit. Mus. (Nat. Hist.), Geol.*, London, **5** : 311–358, pls. 49–55.

—— 1964. 1964. The status of the Ordovician trilobite genera *Prionocheilus* and *Polyeres*. *Geol. Mag., Lond.*, **101** : 95, 96.

—— 1965. A revision of the Ordovician trilobite genus *Bathycheilus* Holub. *Sb. nát. Mus. Praze*, **21B** : 1–10, pls. 1, 2.

DELGADO, J. F. N. 1908. Système silurique du Portugal. Étude de stratigraphie paléontologique. *Mém. Comm. Serv. Geol. Port.*, Lisboa : 1–245, pls. 1–8.

DELO, D. M. 1935. A revision of the phacopid trilobites. *J. Paleont.*, Menasha, **9** : 402–420, 45 figs.

—— 1940. Phacopid trilobites of North America. *Spec. Pap. geol. Soc. Amer.*, New York, **29** : 1–135, 13 pls.

DESTOMBES, J. 1963. Données stratigraphiques sur l'Ordovicien de l'Anti-Atlas (Maroc). *Rev. Inst. Fr. Pétr.*, Paris, **18** : 150–157, 1 fig., 1 table.

DREYFUSS, M. 1948. Contribution à l'étude géologique et paléontologique de l'Ordovicien Supérieur de la Montagne Noire. *Mém. Soc. géol. Fr.*, Paris, **58** : 1–62, 9 pls.

ELLES, G. L. 1904. Some graptolite zones in the Arenig rocks of Wales. *Geol. Mag., Lond.* (5) **1** : 199–211, 3 figs.

—— 1922. The graptolite faunas of the British Isles. A study in evolution. *Proc. Geol. Ass.*, London, **33** : 168–200, figs. 38–52.

—— 1933. The Lower Ordovician graptolite faunas with special reference to the Skiddaw Slates. *Summ. Progr. Geol. Surv. Lond.*, 1932 : 94–111, 13 figs.

GÉZE, B. 1949. Étude géologique de la Montagne Noire et des Cévennes méridionales. *Mém. Soc. géol. Fr.*, Paris, **62** : 215 pp., 7 pls.

GIGOUT, M. 1951. Études géologiques sur la Méséta marocaine occidentale (arrière-pays de Casablanca, Mazagan et Safi). *Trav. Inst. Sci. Chérifien*, Rabat, **3** : 1–507, pls. 1–18.

—— 1954. Sur un Hétérostélé de l'Ordovicien marocain. *Bull. Soc. Sci. nat. Maroc*, Rabat, **34** : 3–7, 2 figs.

—— 1956. Précisions nouvelles sur l'Ordovicien inférieur de la Méséta marocaine occidentale. *C.R. Acad. Sci.*, Paris, **242** : 2738–2741.

HALL, J. 1851. Chapter 13, Description of new, or rare species of fossils, from the Palaeozoic Series. *In* Foster, J. W. & Whitney, J. D., *Report on the geology of the Lake Superior land district, Part* 2 : 203–231, pls. 26–32. Washington.

HARPER, J. C. & RAST, N. 1964. The faunal succession and volcanic rocks of the Ordovician near Bellewstown, Co. Meath. *Proc. Roy. Irish Acad.*, Dublin, **64**(B) : 1–23, 4 pls.

HARRINGTON, H. J. 1938. Sobre las faunas de Ordoviciano Inferior del Norte Argentino. *Revta. Mus. La Plata*, Buenos Aires (n.s.) **1**, Paleo. : 109–289, pls. 1–14.

HARRINGTON, H. J. & LEANZA. 1957. Ordovician trilobites of Argentina. *Univ. Kansas, Lawrence, Dept. Geol. Spec. Pub.*, **1** : 1–276, 140 figs.

HAVLIČEK, V., HORNÝ, R., CHLUPÁČ, I. & ŠNAJDR, M. 1958. Führer zu den Geologischen Exkursionen in das Barrandium. *Sbir. geol. Prův.*, Praha, **1** : 1–171, 19 pls.

HAWLE, I. & CORDA, A. J. C. 1847. Prodrom einer Monographie der böhmischen Trilobiten. *Abh. k. Böhm. Ges. Wiss.*, Prague, **5** : 117–292, 7 pls.

HENNINGSMOEN, G. 1960. The Middle Ordovician of the Oslo Region, Norway. 13. Trilobites of the family Asaphidae. *Norsk. geol. Tidsskr.*, Bergen, **40** : 203–257, pls. 1–14.

HICKS, H. 1875. On the succession of the ancient rocks in the vicinity of St. David's, Pembrokeshire, with special reference to those of the Arenig and Llandeilo groups, and their fossil contents. *Quart. J. geol. Soc. Lond.*, **31** : 167–195, pls. 8–11.

HOLUB, K. 1908. Příspěvek ku poznáni fauny pásma D–$d_1\gamma$. *Rozpr. české Akad.*, Prague (2) **17** 10 : 1–19, 1 fig.

HOWELL, B. F. 1935. Cambrian and Ordovician trilobites from Hérault, southern France. *J. Paleont.*, Menasha, **9** : 222–238, pls. 22, 23.

HUPÉ, P. 1953. Classe des Trilobites. In *Traité de Paléontologie* (ed. J. Piveteau), Paris, **3** : 44–246, 140 figs.

KLOUČEK, C. 1916. O vrstvách D–$d_1\gamma$, jich trilobitech a nalezištích. *Rospr. česke Akad.*, Prague, (2) **25** : 1–21, 1 pl.

KOBAYASHI, T. 1934. The Cambro-Ordovician formations and faunas of South Chosen. Palaeontology. Part I. Middle Ordovician faunas. *J. Fac. Sci. Imp. Univ. Tokyo* (sec. 2) **3** : 329–519, pls. 1–44.

—— 1937. The Cambro-Ordovician shelly faunas of South America, II. *J. Fac. Sci. Imp. Univ. Tokyo* (4) **4** : 369–522, pls. 1–8.

—— 1939. On the Agnostids, Pt. 1. *J. Fac. Sci. Imp. Univ. Tokyo* (2) **5** : 66–198.

—— 1960. Some Ordovician fossils from East Tonkin, Viet Nam. *Jap. J. Geol. Geogr.*, Tokyo, **31** : 39–48, pl. 5.

LAKE, P. 1906. A Monograph of the British Cambrian trilobites, **1**. *Palaeontogr. Soc.* [*Monogr.*] London, pp. 1–28, pls. 1, 2.

—— 1942. A Monograph of the British Cambrian Trilobites, **13**. *Palaeontogr. Soc.* [*Monogr.*] London, pp. 307–332, pls. 44–46.

LU, Y. H. 1957. *Trilobita* in *Index Fossils of China, Invertebrate*, Peking, **3** : 249-294, pls. 137–155.

—— 1963. The ontogeny of *Hanchungolithus multiseriatus* (Endo) and *Ningkianolithus welleri* (Endo), with a brief note on the classification of the Trinucleidae. *Acta palaeont. sin.*, Peking, **11** : 319–339, 3 pls.

—— 1964. Ontogeny of *Hanchungolithus multiseriatus* (Endo) and *Ningkianolithus welleri* (Endo) (TRILOBITA). *Sci. sin.*, Peking, **13** : 291–308, 3 pls.

MÄNNIL, P. M. 1958. Trilobites of the families Cheiruridae and Encrinuridae from Estonia. *Geologia Inst. Uuvim.*, Tallin, **3** : 165–212, 8 pls.

M'COY, F. 1846. *A synopsis of the Silurian fossils of Ireland.* 72 pp., 5 pls. Dublin.

MIQUEL, J. 1895. Note sur la géologie des terrains primaires du département de l'Hérault. Essai de stratigraphie générale. *Bull. Soc. Sci. nat. Béziers*, **18** : 5–28, 2 pls.

MOBERG, J. C. & SEGERBERG, C. O. 1906. Bidrag till kännedomen om Ceratopygeregionen med särskild hänsyn till dessutveckling i Fogelsångstrakten. *Acta Univ. lund.* (n.s.) **2** : 1–113, 7 pls.

MOORE, R. C. 1959. *Treatise on Invertebrate Paleontology. Part* O. *Arthropoda I.* xix+560 pp., 415 figs. Lawrence & Meriden.

NOVÁK, O. 1883. Zur Kenntniss der böhmischen Trilobiten. *Beitr. Paläont. Geol. Öst.-Ung.*, Wien, **3** : 23–63, pls. 8–12.

ÖPIK, A. 1937. Trilobiten aus Estland. *Acta Univ. dorpat.* (*tartu*), (A) **32** : 1–163, pls. 1–26.

PALMER, A. L. 1955. Upper Cambrian Agnostidae of the Eureka district, Nevada. *J. Paleont.*, Menasha, **29** : 86–101, pls. 19, 20.

PERNER, J. 1918. Die Trilobiten der Zone D–$d_1\gamma$ von Prag und Umgebung. *Palaeontogr. Bohem.*, Prague, **9** : 29–51, 4 pls.

PHILIPPOT, A. 1950. Les Graptolites du Massif Armoricain. Etude stratigraphique et paléontologique. *Mém. Soc. géol. minér. Bretagne*, Rennes **8** : 1–295, 22 figs.

POMPECKJ, J. F. 1898. Ueber *Calymmene* Brongniart. *Neues Jb. Miner.*, Stuttgart, **1** : 187–250.

—— 1903. *Calymene Tristani* Brongniart, 1822. In *Palaeontologia Universalis*, Paris, **1** : 1, 1a–c.

PRANTL, F. & PŘIBYL, A. 1949. A study of the superfamily Odontopleuracea nov. superfam. (trilobites). *Rozpr. St. geol. Ust.*, Praha, **12** : 119–221, 11 pls.

—— 1949a. On the genus *Symphysurus* Goldfuss and allied forms from the Ordovician of Bohemia (Trilobitae). *Věst. České Společ. Nauk*, Praha, **12** : 1–16, 2 pls.

RAYMOND, P. E. 1914. Notes on the ontogeny of *Isotelus gigas* Dekay. *Bull. Mus. Comp. Zool.*, Cambridge, **58** : 247–263, 3 pls.

REED, F. R. C. 1903. The Lower Palaeozoic trilobites of the Girvan district, Ayrshire, **1**. *Palaeontogr. Soc.* [*Monogr.*] London, pp. 1–48, pls. 1–6.

—— 1912. Ordovician and Silurian fossils from the Central Himalayas. *Palaeont. indica*, Calcutta, **7** : i–v, 1–168, pls. 1–20.

—— 1918. Notes on the genus *Homalonotus*. *Geol. Mag., Lond.* (6) **5** : 236–276, 314–327.

—— 1931. A review of the British species of the Asaphidae. *Ann. Mag. nat. Hist.*, London (10) **7** : 441–472.

RIBEIRO, C. 1853. On the Carboniferous and Silurian formations of the neighbourhood of Bussaco in Portugal. With notes and a description of the animal remains by Daniel Sharpe, J. W. Salter and T. Rupert Jones : and an account of the vegetable remains, by Charles J. F. Bunbury. *Quart. J. Geol. Soc. Lond.*, **9** : 135–161, pls. 7–9.

ROSS, R. J. 1951. Stratigraphy of the Garden City Formation in northeastern Utah, and its trilobite faunas. *Bull. Peabody Mus.*, New Haven, **6** : 1–161, 36 pls.

—— 1958. Trilobites in a pillow-lava of the Ordovician Valmy formation, Nevada. *J. Paleont.*, Menasha, **32** : 559–570, pls. 83, 84.

ROUAULT, M. 1847. Extrait du Mémoire sur les Trilobites du département d'Ille-et-Vilaine. *Bull. Soc. géol. Fr.*, Paris (2) **4** : 309–328, pl. 3.

—— 1849. Mémoire 1° sur la compositon du test des Trilobites ; 2° sur les changements de formes dus à des causes accidentelles, ce qui a pu permettre de confondre des espèces différentes. *Bull. Soc. géol. Fr.*, Paris (2) **6** : 67–89, pls. 1, 2.

—— 1851. Mémoire sur le terrain paléozoique des environs de Rennes. *Bull. Soc. géol. Fr.*, Paris (2) **8** : 358–399, 4 figs.

SALTER, J. W. 1865. A Monograph of the British Trilobites of the Cambrian, Silurian and Devonian Formations, **2**. *Palaeontogr. Soc.* [*Monogr.*] London, pp. 81–128, pls. 7–14.

SALTER, J. W. & BLANFORD, H. F. 1865. *Palaeontology of Niti in the Northern Himalaya: being descriptions and figures of the Palaeozoic and Secondary fossils collected by Colonel Richard Strachey, R.E.* 112 pp., 23 pls. Calcutta.

SALTER, J. W. & ETHERIDGE, R. 1881. On the fossils of North Wales. *In* Ramsay, A. C., "The geology of North Wales". *Mem. Geol. Surv.*, London, **3** (2nd. edit.) : 331–611, pls. 1–26.

SDZUY, K. 1955. Die Fauna der Leimitz-Schiefer (Tremadoc). *Abh. Senckenb. naturf. Gesell.*, Frankfurt a.M., **492** : 1–74, 8 pls.

SHENG, S. F. 1958. The Ordovician trilobites of southwestern China. *Acta palaeont. sin.*, Peking, **6** : 183–204, pls. 1–7.

SMITH, S. 1933. On the occurrence of Tremadoc shales in the Tortworth Inlier (Gloucestershire). With notes on the fossils by C. J. Stubblefield. *Quart. J. Geol. Soc. Lond.*, **89** : *Ust.* 357–377, pl. 34.

ŠNAJDR, M. 1956. Trilobiti drabovských a letenských vrstev českého ordoviku. *Sborn. Úsťř. geol.*, Prague, **22** : 477–533, pls. 32–37.

SPENCER, W. K. 1950. Asterozoa and the study of Palaeozoic faunas. *Geol. Mag., Lond.*, **87** : 393–408.

SPJELDNAES, N. 1961. Ordovician climatic zones. *Norsk. geol. Tidsskr*, Bergen, **41** : 45–77, 7 figs.

STETSON, H. C. 1927. The distribution and relationships of the Trinucleidae. *Bull. Mus Comp. Zool.*, Cambridge, **68** : 87–104, 1 pl.

STØRMER, L. 1921. Om nogen fossilfund fra etage 3a*a* ved Vaekkerø, Kristiania. *Norsk. geol. Tidsskr.*, Kristiania, **6** : 1–15, 2 pls.

STRUVE, W. 1958. Die Zeliszkellinae. *Senckenbergiana*, Frankfurt a.M., **39** : 165–219, 4 pls.

STUBBLEFIELD, C. J. 1939. Some aspects of the distribution and migration of trilobites in the British Lower Palaeozoic faunas. *Geol. Mag., Lond.*, **76** : 49–72.

SUDBURY, M. 1957. *Diplograptus spinulosus* sp. nov., from the Ordovician of Syria. *Geol. Mag., Lond.*, **94** : 503–506, 1 fig.

TERMIER, G. & H. 1950. Paléontologie Marocaine, **2**. *Actual sci. ind.* Paris, **1095** : 1–279. pls. 184–241.

THADEU, D. 1949. Calimenídeos portugueses. *Bol. Soc. Geol. Portugal*, Porto, **8** : 129–134, 2 pls.

—— 1956. Note sur le Silurien beiro-durien. *Bol. Soc. geol. Portugal*, Porto, **12** : 1–38, pls. 1–10.

THORAL, M. 1933. Stratigraphie de l'Ordovicien de la vallée du Landayran (Hérault). *C.R. Somm. Soc. géol. Fr.*, Paris, **11** : 147–148.

—— 1935. Contribution à l'étude géologique des Monts de Lacaune et des Terrains Cambriens et Ordoviciens de la Montagne Noire. *Bull. Serv. Carte géol. Fr.*, Paris & Liege, **38** (192) : 1–637, 5 pls.

—— 1935*a*. *Contribution à l'étude paléontologique de l'Ordovicien inférieur de la Montagne Noire et révision sommaire de la faune Cambrienne de la Montagne Noire.* 362 pp., 35 pls. Montpellier.

—— 1941. Stratigraphie et faciès de l'Arenig languedocien. *Ann. Univ. Lyon* (C) **2** : 99–150, 2 pls.

—— 1941*a*. Ordovicien supérieur, Gothlandien et Orogénèse calédonienne en Languedoc. *Bull. Soc. Et. Sci. Aude*, Carcassone, **45** : 182–195, 1 table.

—— 1946. Cycles géologiques et formations nodulifères de la Montagne Noire. *Nouv. Arch. Mus. Hist. nat. Lyon*, **1** : 1–103, 16 pls.

TJERNVIK, T. E. 1956. On the early Ordovician of Sweden. Stratigraphy and fauna. *Bull. geol. Instn. Univ. Uppsala*, **36** : 107–284, pls. 1–11.

VANĚK, J. 1965. New species of the Suborder Calymenina Swinnerton, 1915 (Trilobita) from the Barrandian area. *Sb. geol. Věd.*, Praha, řada P, **6** : 21–37, pls. 1–4.

Van Leckwijck, W., Suter, G. & Termier, H. & G. 1955. Contribution à la stratigraphie des terrains Ordoviciens et Gothlandiens de L'Anticlinorium de Khouribga-Oulmès (Maroc Central). *Notes Mém. Serv. géol. Maroc*, Rabat, **123** : 1–44, 1 map.

Verneuil, E. de & Barrande, J. 1855. Description des fossiles trouvés dans les terrains silurien et dévonien d'Almaden, d'une partie de la Sierra Morena et des montagnes de Tolède. *Bull. Soc. géol. Fr.*, Paris (2) **12** : 964–1025, pls. 23–29.

Vogdes, A. W. 1925. Palaeozoic Crustacea. Part II. A list of the genera and subgenera of the Trilobita. *Trans. San Diego Soc. Nat. Hist.*, **4** : 87–115.

Whittard, W. F. 1955. The Ordovician trilobites of the Shelve Inlier, West Shropshire, **1**. *Palaeontogr. Soc.* [*Monogr.*] London, pp. 1–40, pls. 1–4.

—— 1957. "*Trinucleus*" *primitivus* from the south of France. *Senckenbergiana*, Frankfurt a.M., **38** : 267–274, 1 pl.

—— 1960. The Ordovician trilobites of the Shelve Inlier, West Shropshire, **4**. *Palaeontogr. Soc.* [*Monogr.*] London, pp. 117–162, pls. 16–21.

—— 1960*a*. "Ordovician System" *in* Lexique Stratigraphique International, Vol. I, Europe (dir. by P. Pruvost), Paris, **3a** (4) : 5–26.

—— 1961. The Ordovician trilobites of the Shelve Inlier, West Shropshire, **5**. *Palaeontogr. Soc.* [*Monogr.*] London, pp. 163–196, pls. 22–25.

—— 1964. The Ordovician Trilobites of the Shelve Inlier, West Shropshire, **7**. *Palaeontogr. Soc.* [*Monogr.*] London, pp. 229–264, pls. 34–45.

Whittington, H. B. 1950. Sixteen Ordovician genotype trilobites. *J. Paleont.*, Menasha, **24** : 531–565, pls. 68–75.

—— 1953. A new Ordovician trilobite from Florida. *Breviora*, Cambridge, **17** : 1–6, 1 pl.

—— 1956. Silicified Middle Ordovician trilobites : the Odontopleuridae. *Bull. Mus. Comp. Zool. Harv.*, Cambridge, **114** : 155–288, pls. 1–24.

—— 1959. Silicified Middle Ordovician trilobites : Remopleurididae, Trinucleidae, Raphiophoridae, Endymionidae. *Bull. Mus. Comp. Zool. Harv.*, Cambridge, **121** : 371–496, pls. 1–36.

—— 1961. Middle Ordovician Pliomeridae (Trilobita) from Nevada, New York, Quebec, Newfoundland. *J. Paleont.*, Menasha, **35** : 911–922, pls. 101, 102.

—— 1963. Middle Ordovician trilobites from Lower Head, Western Newfoundland. *Bull. Mus. Comp. Zool. Harv.*, Cambridge, **129** : 1–118, pls. 1–36.

—— 1965. *Platycoryphe*, an Ordovician homalonotid trilobite. *J. Paleont.*, Menasha, **39**: 487–491, pl. 64.

Whittington, H. B. & Evitt, W. R. 1954. Silicified Middle Ordovician trilobites. *Mem. Geol. Soc. Amer.*, New York, **59** : 1–137, 33 pls.

Wilson, J. L. 1954. Late Cambrian and early Ordovician trilobites from the Marathon Uplift, Texas. *J. Paleont.*, Menasha, **28** : 249–285, pls. 24–27.

EXPLANATION OF PLATES

Most of the trilobites illustrated are in the collections of the British Museum (Natural History) and their numbers are prefixed I., In. or It. Some are in the Geological Institute of the University of Montpellier, whilst the originals of the figured casts of *Geragnostus tullbergi* (Novák) are in the National Museum, Prague. The localities cited for the Landeyran Valley—Le Foulon district are shown in Text-figs. 3 and 5. The specimens were whitened with ammonium chloride before photographing. Photographs by the writer.

PLATE 1

Geragnostus occitanus Howell   p. 274

Couches du Landeyran inférieures, locality λ31,
hill-side section south-west of Le Foulon.

FIG. 1. Internal mould of dorsal exoskeleton. It.140. ×8.
FIG. 4. Latex cast showing poorly-defined pygidial axis. It.143. ×7.
FIGS. 7, 12. Left lateral and plan views of internal mould. It.146. ×8.
FIG. 10. Latex cast showing anterior margin of pygidium. It.148. ×7.

Horizon as for Fig. 1. Locality λ32, hill-side
section south-west of Le Foulon.

FIG. 2. Latex cast of small individual. It.141. ×8.
FIG. 3. Internal mould of cephalon. It.142. ×9.
FIG. 6. Latex cast showing broad pygidial border. It.145. ×8.
FIGS. 8, 11. Internal mould and latex cast of pygidium and thorax, showing slight difference in definition of pygidial axis. It.147. ×8.

Horizon as for Fig. 1. Locality λ5, near northern
end of Landeyran Valley.

FIGS. 5, 9. Oblique right lateral and plan views of dorsal exoskeleton, an internal mould with cephalon slightly displaced. It.144. ×7.

PLATE 1

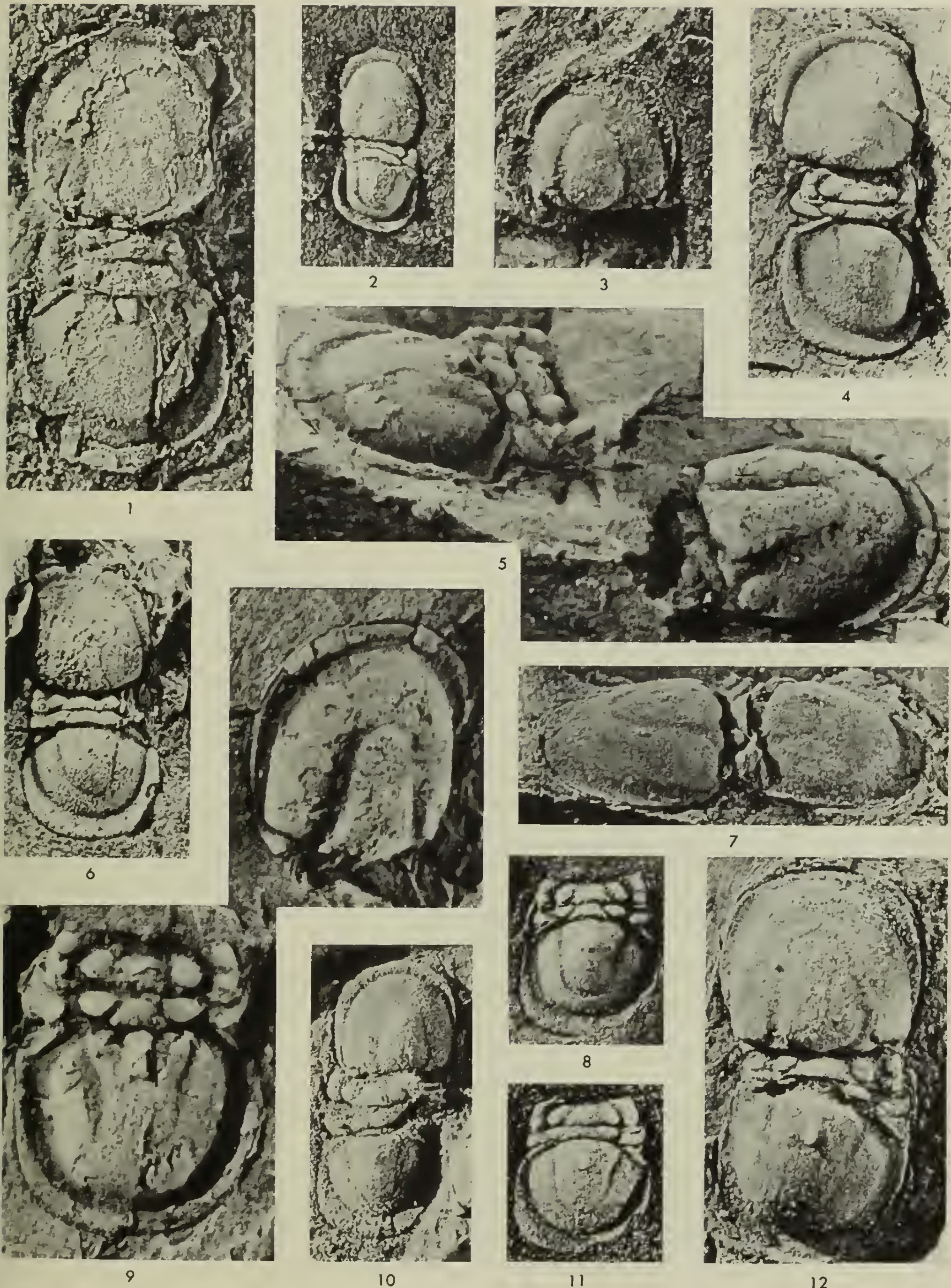


PLATE 2

Geragnostus occitanus Howell p. 274

Couches du Landeyran inférieures, locality $\lambda 2$,

river bank near northern end of Landeyran Valley.

FIG. 1. Latex cast, FIGS. 2, 3, internal mould. The latter has the second thoracic segment removed to show front of pygidium. In.57418 (Fig. 1), In.57419 (Figs. 2, 3). ×9.

FIG. 7. Plan view of internal mould of cranidium. In.57417. ×10.

Geragnostus tullbergi (Novák) p. 273

Šárka Beds (Llanvirn Series), Šárka, near Prague, Czechoslovakia.

FIG. 4. Cast of pygidium associated with other specimens of same species in small, siliceous concretion. Original in National Museum, Prague. ×4.

FIG. 9. Enlargement of same pygidium showing poorly-defined tip of axis with median tubercle. ×8.

FIG. 10. Latex cast of associated enrolled individual showing left pleural tips and articulation of thorax. ×10.

Geragnostus mediterraneus Howell p. 277

Horizon and locality as for Fig. 1.

FIGS. 5, 6, 8. Posterior, left lateral and plan views of internal mould of pygidium. In.57420. ×9.

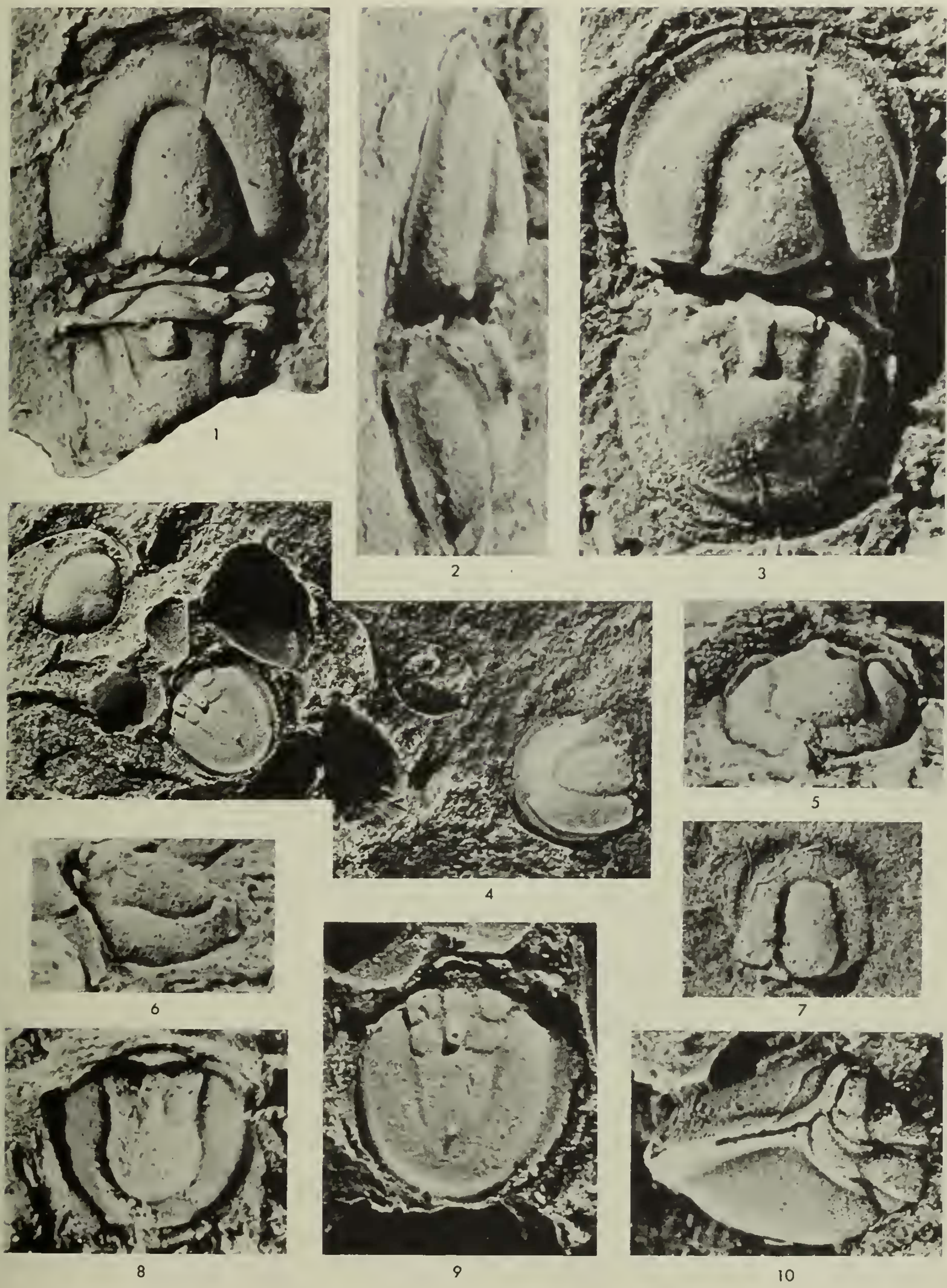

1
2
3
4
5
6
7
8
9
10

PLATE 3

Ampyx priscus Thoral p. 279

Couches du Landeyran inférieures, locality $\lambda 32$,
hillside section south-west of Le Foulon.

FIG. 1. External mould of cephalon. It.150*b*. ×6.
FIG. 7. Internal mould of hypostoma. It.150*a*. ×12.

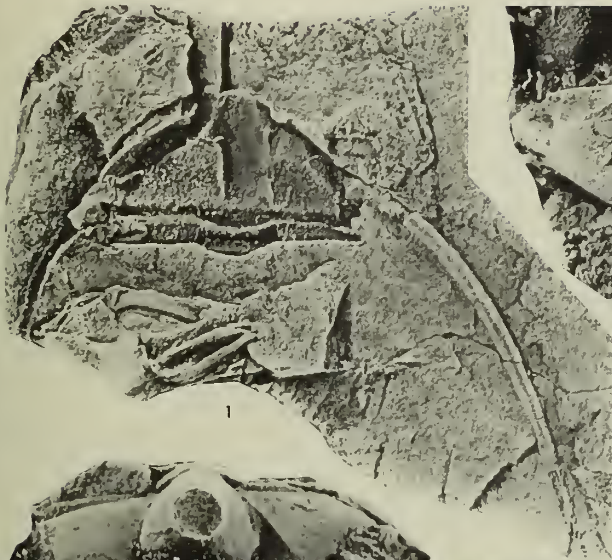
Horizon probably as for Fig. 1. " St. Chinian "
(no precise data).

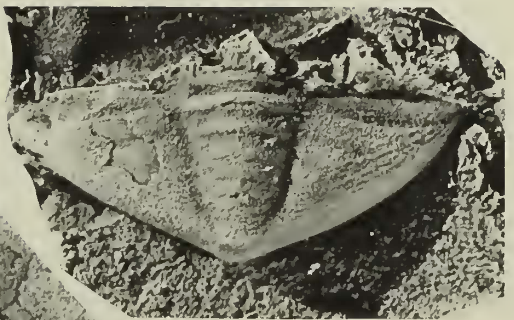
FIGS. 2, 8. Cast of paralectotype pygidium, University of Montpellier. Original figured Thoral, 1935*a*, pl. 28, fig. 10. Plan and posterior views, ×6.
FIGS. 3, 4, 9. Cast of lectotype cranidium, University of Montpellier. Original figured Thoral 1935*a*., pl. 28, fig. 9. Anterior, left lateral and plan views, ×4.

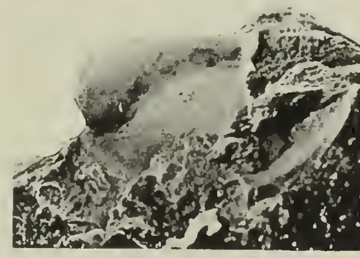
Horizon probably as for Fig. 1.
" Boutoury ", near Cabrières (no precise data).

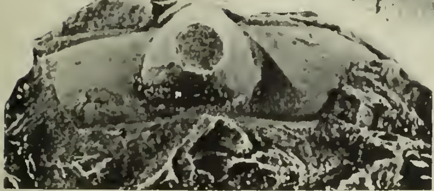
FIG. 5. Internal mould of almost complete individual. University of Montpellier. ×5.
Horizon probably as for Fig. 1. Landeyran Valley (no precise data).

FIG. 6. Internal mould, somewhat damaged and abraded. Escot Coll., I.15880. ×5.


1


2

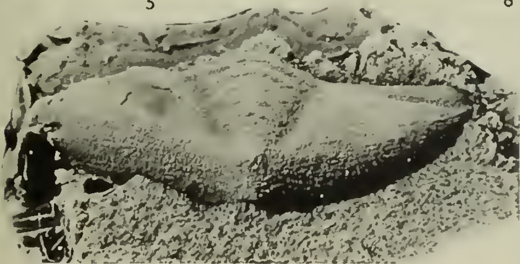

4


3


7


5


6


8


9

PLATE 4

Ampyx priscus Thoral p. 279.

Couches du Landeyran inférieures. Locality λ32,
hillside section south-west of Le Foulon.

FIG. 1. Two enrolled individuals showing external mould of dorsal side of thorax and ventral side of librigenal spines. Hypostoma preserved as internal mould (for enlargement see Pl. 3, fig. 7). It.150*a*. ×6·5.

FIG. 4. Latex cast of small pygidium with one attached thoracic segment. It.153*b*. ×8.

FIG. 5. Internal mould of cephalon and thorax with external mould of librigenal spines. It.154. ×6·2.

FIG. 6. Latex cast of cranidium. It.155*b*. ×6·2.

Horizon as for Fig. 1.
Locality λ33, hillside section south-west of Le Foulon.

FIG. 2. External mould of small cranidium with attached thorax and pygidium. It.151*b*. ×8.

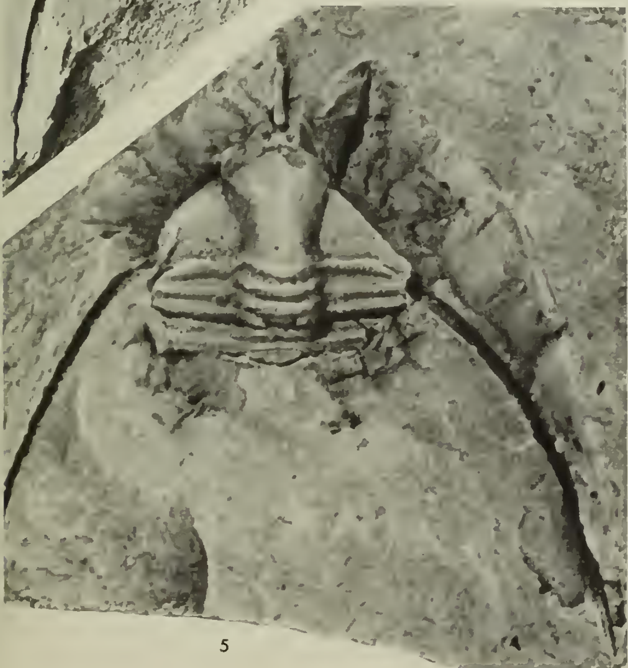
FIG. 3. Internal mould of cranidium. It.152*a*. ×8.

1

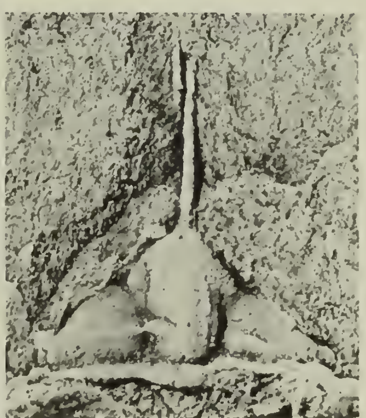
2

3

4



5



6

PLATE 5

Hanchungolithus primitivus (Born)   p. 281

Couches du Landeyran supérieures, locality λ16,
near southern end of Landeyran Valley.

FIG. 1. Latex cast of meraspid cephalon showing ocular ridges and alar lobes. In.56551. ×10.

FIGS, 2, 5. Plan and anterior views of latex cast of dorsal exoskeleton showing, *inter al.*, marginal suture. In.56534. ×7·5.

FIG. 8. Latex cast of small meraspid cephalon. Note ocular ridges, alar lobes, thick cephalic margin and librigenal spines. In.58600. ×10.

Horizon as for Fig. 1.

Locality λ20, near southern end of Landeyran Valley.

FIG. 3. Internal mould of cephalon showing marginal position of girder. In.58591. ×9.

FIG. 4. Specimen showing dorsal side of internal mould of cephalic fringe. Centre of cephalon has broken away to show external mould of enrolled thorax. In.57935. ×8.

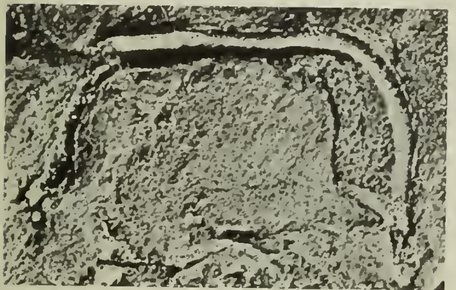
FIG. 6. Latex cast of Meraspis (probably Degree 4). In.58596. ×7.

FIG. 7. Latex cast of two small cephala, the uppermost with well-developed alar lobes. In.57939. ×10.

FIG. 9. Two individuals showing external mould of dorsal fringe surface and internal mould of thorax. In.58594. ×4.

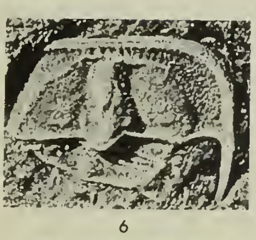

1


2

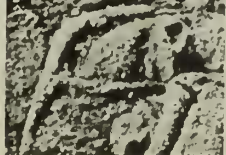

3


4


5


6


7


8

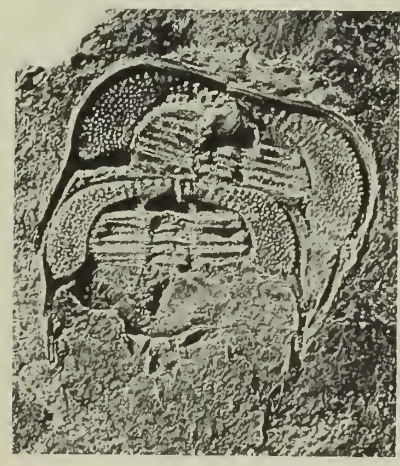

9

PLATE 6

Pliomerops escoti (Bergeron) p. 284

Couches du Landeyran inférieures, locality $\lambda 2$,
in north-western bank of river near northern end of Landeyran Valley.

FIGS, 1, 2. Internal mould and latex cast of hypostoma provisionally assigned to the species. It.158. ×4·5.

FIG. 3. Latex cast of slightly crushed cranidium. It.159. ×4.

FIG. 9. Latex cast of transitory pygidium, Meraspis, Degree 13. It.161. ×6·5.

Horizon as for Fig. 1.
Exact locality in Landeyran Valley unspecified
but probably near the northern end.

FIG. 4. Latex cast of slightly disarticulated dorsal exoskeleton. Escot Coll., I.15877. ×3·75.

FIGS. 6, 8, 10. Posterior, oblique right lateral and plan views of internal mould of pygidium. Escot Coll., I.15878. ×4·5.

Ceraurinella peregrinus sp. nov. p. 287

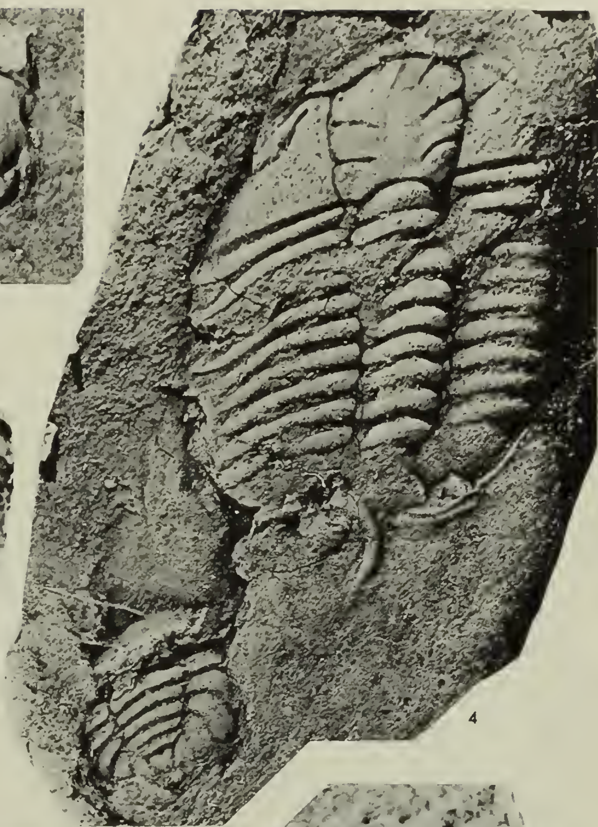
Horizon as for Fig. 1. Locality $\lambda 32$, hillside
section south-west of Le Foulon.

FIGS, 5, 7. Plan and left lateral views of latex cast of damaged cranidium. Paratype, It.169. ×6·5.

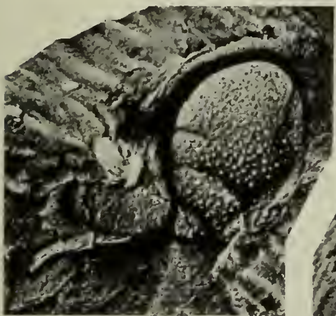
1

2

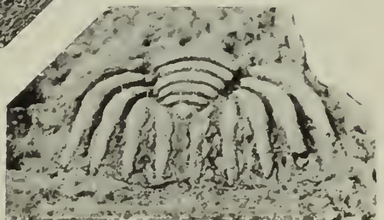
3



4



5



6

7

8

9

10

PLATE 7

Ceraurinella peregrinus sp. nov. p. 287

Couches du Landeyran inférieures, from unspecified
locality or localities near Le Foulon.

FIGS. 1, 2, 7. Posterior, right anterolateral and plan views of an internal mould. Holotype, Guiraud Coll., University of Montpellier. $\times 3$.

FIGS. 3, 6. External mould and latex cast of hypostoma of holotype. $\times 8$.

FIG. 4. Latex cast of pygidium and part of thorax. Paratype, Guiraud Collection, University of Montpellier. $\times 3$.

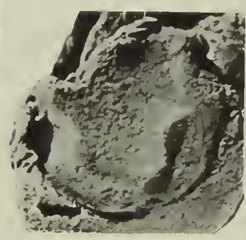
FIGS. 8, 9. Internal mould and latex cast of pygidium, thorax and fragment of cephalon. Paratype, Guiraud Collection, University of Montpellier. $\times 3$.

Horizon as for Fig. 1. Locality $\lambda 2$ in north-western bank of river,
near northern end of Landeyran Valley.

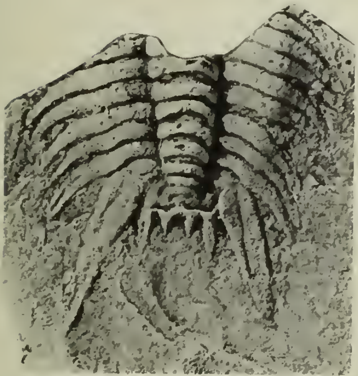
FIG. 5. Latex cast of small cranidium. Paratype, It.160. $\times 6$.

1

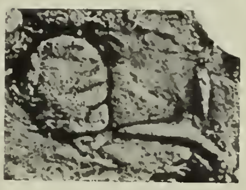
2



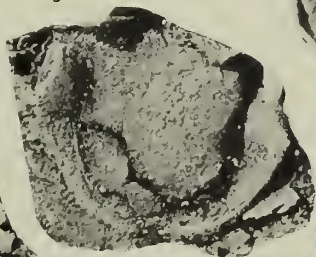
3



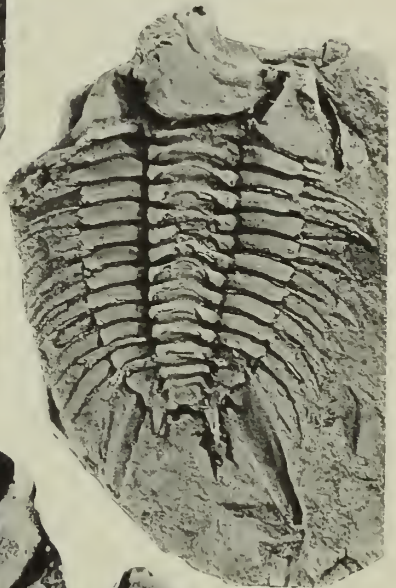
4



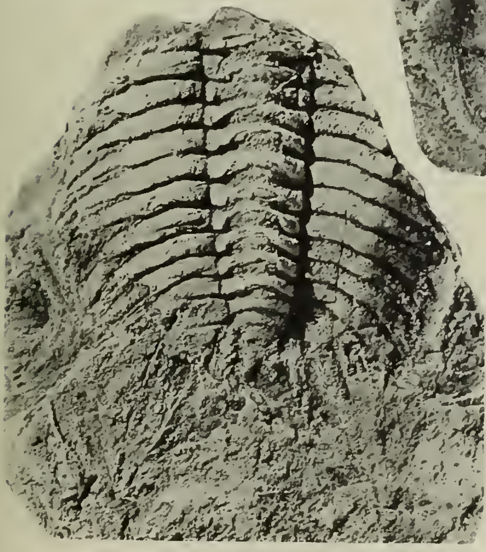
5



6



7



8

9

PLATE 8

Ormathops borni sp. nov. p. 292

Couches du Landeyran supérieures, locality λ16,
near southern end of Landeyran Valley.

FIGS. 1, 6. Plan and left lateral views of internal mould of dorsal exoskeleton. Paratype, In.56620. $\times$ 7.

FIGS. 2–4. Anterior, left lateral and plan views of internal mould of cephalon. Paratype, In.57448. $\times$ 8.

FIG. 7. Left lateral view of latex cast of damaged cephalon showing eye facets, cheek and facial suture. Paratype, In.56614. $\times$ 10.

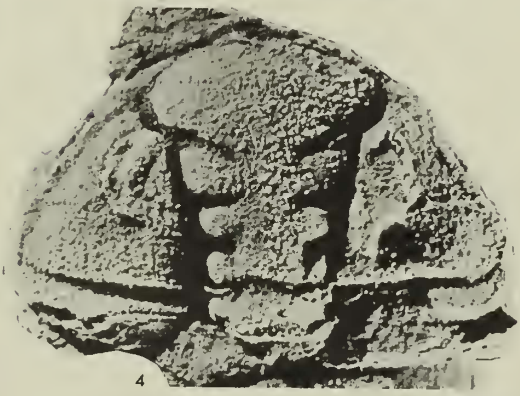
FIG. 8. Internal mould of small individual Paratype, In.56557. $\times$ 8.

Couches du Landeyran inférieures, locality λ33,
hillside section south-west of Le Foulon.

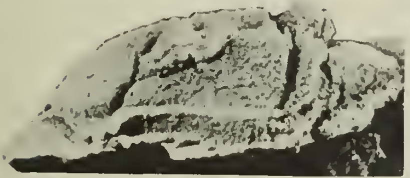
FIG. 5. Plan view of cephalon, an internal mould. It.285. $\times$ 6.

1

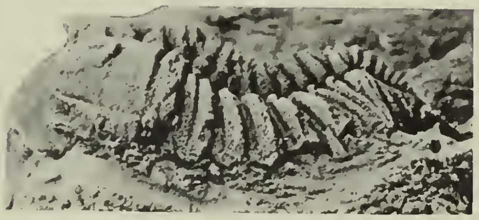
2



4



3



6

5

7

8

PLATE 9

Ormathops borni sp. nov. p. 292

Couches du Landeyran supérieures, locality λ16,
near southern end of Landeyran Valley.

FIG. 1. Internal mould of cephalon showing impression of doublure. Paratype, In. 57772. ×5·5.

FIG. 2. Latex cast of small hypostoma. Paratype, In. 56613. ×15.

FIG. 3. Internal mould of small cranidium. Paratype, In. 56609. ×7.

FIGS. 4, 9, 10. Anterior, left lateral and plan views of holotype cephalon, an internal mould. In. 57447. ×5·5.

FIGS. 5, 12. Latex cast of pygidium. Paratype, In. 57898. ×6·5.

FIG. 11. Latex cast showing cephalic border. Paratype, In. 57953. ×5.

FIG. 13. Latex cast of small cephalon showing well-developed fixigenal spine. Paratype, In. 57446. ×12.

Horizon as for Fig. 1.
Locality λ17, near southern end of Landeyran Valley.

FIG. 7. Internal mould of small individual showing fixigenal spine and cephalic test. In. 56588. ×6.

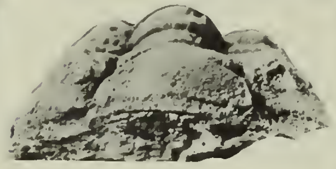
Couches du Landeyran inférieures, locality λ33,
hillside section south-west of Le Foulon.

FIGS. 6, 8. Internal mould and latex cast of slightly compressed pygidium. It. 286. ×6.

1

2

3



4

5

6

7

8

9

10

11

12

13

PLATE 10

Prionocheilus matutinus sp. nov. p. 300

Couches du Landeyran inférieures, locality $\lambda 2$,
near northern end of Landeyran Valley.

FIG. 1. Internal mould of cranidium, thorax and part of pygidium. Paratype, It.162. ×4·5.

FIG. 2. Latex cast of librigena showing small ventral spines. Paratype, In.57486*b*. ×10.

FIG. 3. Latex cast of small pygidium with fragment of thorax. Paratype, In.57430. ×9.

FIG. 6. Latex cast of small cranidium. Paratype, It.164. ×11.

FIG. 7. Latex cast of incomplete cranidium, showing paraglabellar areas and granulated test. Holotype, In.57434*b*. ×6·5.

Bathycheilus gallicus Dean p. 298

Horizon as for Fig. 1. Unspecified locality near Le Foulon.

FIG. 4. Internal mould of dorsal exoskeleton. Guiraud Coll., University of Montpellier. ×4·5.

Horizon and locality as for Fig. 1.

FIG. 8. Internal mould of hypostoma. In.57482. ×6·5.

FIG. 12. Latex cast of fragmentary cephalon. In.57483. ×5·3.

Horizon as for Fig. 1.
Locality $\lambda 32$, hillside section south-west of Le Foulon.

FIG. 9. Latex cast of two cranidia. It.165. ×4·5.

Horizon as for Fig. 1.
Locality $\lambda 33$, hillside section south-west of Le Foulon.

FIG. 10. Latex cast of small cranidium (?Meraspis). It.166. ×12.

FIG. 11. Internal mould of cranidium, probably small Holaspis. It.167. ×4·5.

Colpocoryphe thorali sp. nov. p. 304

Horizon and locality as for Fig. 9.

FIG. 5. Latex cast of Meraspis cranidium and thorax. Paratype, It.168. ×10.

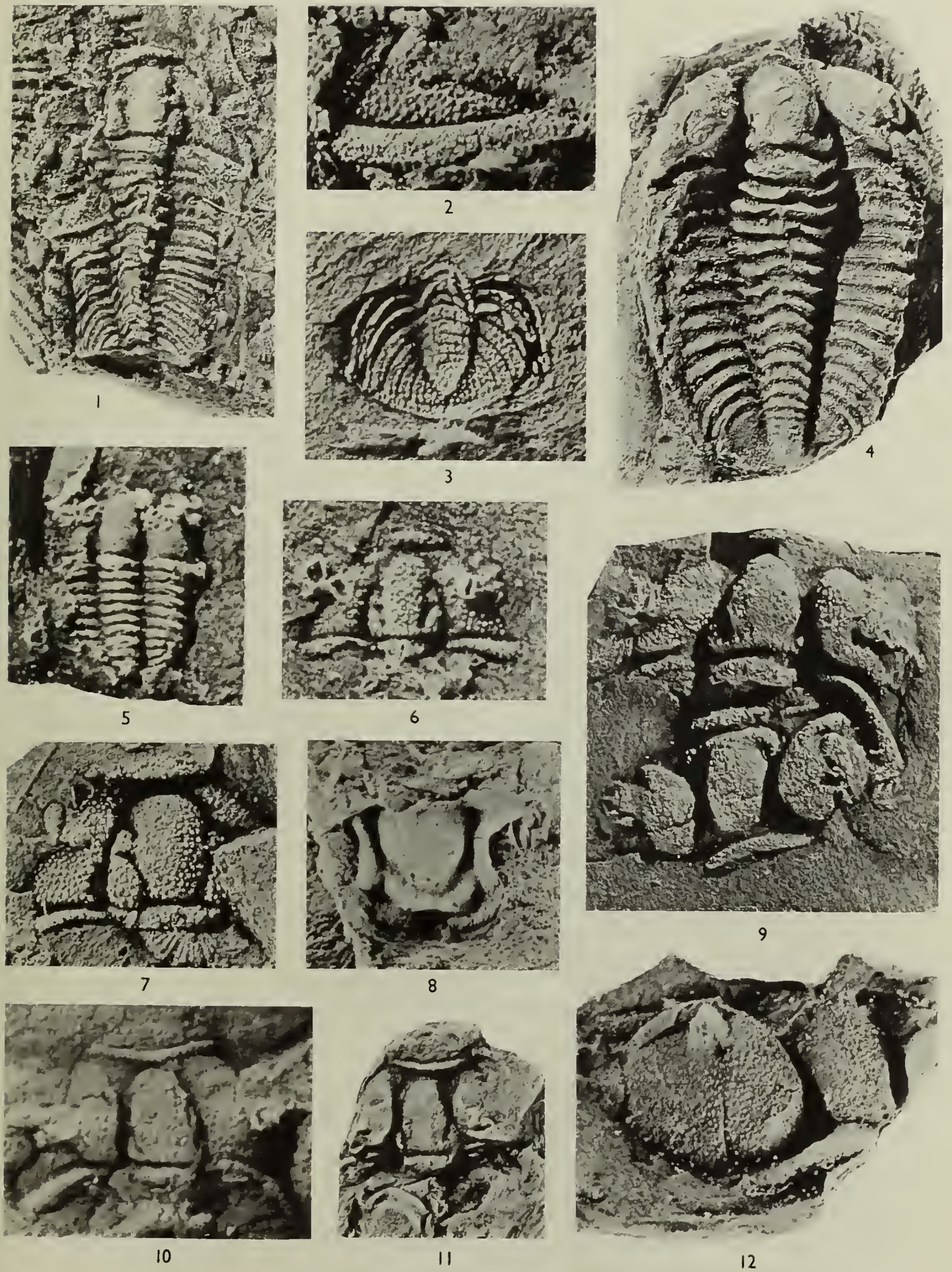

1
2
3
4
5
6
7
8
9
10
11
12

PLATE 11

Colpocoryphe thorali sp. nov. p. 304

Couches du Landeyran supérieures, locality λ16,
near southern end of Landeyran Valley.

FIG. 1. Latex cast of small pygidium. Paratype, In.57622. ×9.

Couches inférieures du Landeyran, locality λ32,
hillside section south-west of Le Foulon.

FIGS. 2, 10. Internal mould of cephalon. It.170, ×4·25.
FIGS. 3, 8. External mould of exoskeleton with internal mould of hypostoma in place. It.171. Fig. 3, ×8. Fig. 8, ×5.

Horizon as for Fig. 2.
Locality λ31, hillside section south-west of Le Foulon.

FIG. 4. Latex cast of small, partially disarticulated exoskeleton. It.172. ×8.

Horizon as for Fig. 1.
Locality λ19, near southern end of Landeyran Valley.

FIG. 5. Internal mould of cranidium of small Meraspis. In.57510. ×14.
FIG. 7. Latex cast of cranidium of small Meraspis. In.57498. ×12.
FIG. 9. Latex cast of small individual (? Meraspis Degree 11). In.57504. ×14.

Horizon as for Fig. 1.
Locality λ20, near southern end of Landeyran Valley.

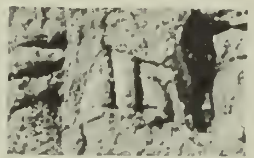
FIG. 6. Internal mould of small, slightly compressed cranidium. Paratype,In.57586. ×6.

1

2

3

4



5

6

7

8

9

10

PLATE 12

Colpocoryphe thorali sp. nov. p. 304

Couches du Landeyran supérieures, locality λ20, near southern end of Landeyran Valley.

FIG. 1. Latex cast of whole exoskeleton. Paratype, In.57552. ×4.
FIG. 4. Internal mould of small pygidium. In.57594. ×12.

Horizon as for Fig. 1.
Locality λ16, near southern end of Landeyran Valley.

FIGS. 2, 6, 9. Left lateral, anterior and plan views of latex cast of cephalon. Holotype, In.56654. ×6.
FIG. 3. Latex cast of hypostoma. Paratype, In.57438. ×10.

Couches du Landeyran inférieures, locality λ32, hillside section south-west of Le Foulon.

FIGS. 5, 8. Internal mould of cephalon and part of thorax. It.173. ×4.

Horizon as for Fig. 5.
Locality λ2, near northern end of Landeyran Valley.

FIG. 7. Latex cast of small exoskeleton (? Meraspis Degree 12). It.174. ×4·5.

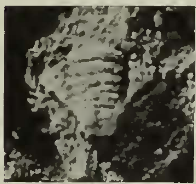
Horizon as for Fig. 1.
Locality λ19, near southern end of Landeyran Valley.

FIG. 10. Internal mould of right librigena showing visual surface of eye. In.57502. ×10.
FIG. 11. Latex cast of small pygidium with six attached thoracic segments. In.57516. ×6.

1

2

3



4

5

6

7

8

9

10

11

PLATE 13

Neseuretus antetristani sp. nov. p. 310

Couches du Landeyran supérieures, locality λ20, near southern end of Landeyran Valley.

FIG. 1. Internal mould of pygidium. Paratype, In. 57478. ×6.

Horizon as for Fig. 1.
Locality λ17, near southern end of Landeyran Valley.

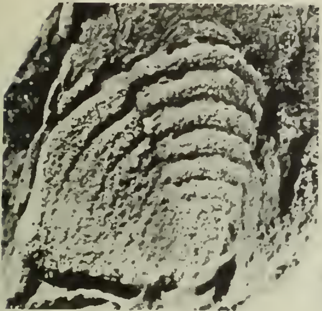
FIGS. 2, 6, 7. Plan, left lateral and posterior views of internal mould of pygidium. Paratype, In. 57473. ×2.

FIGS. 3, 5. Plan, anterior and right lateral views of latex cast of cranidium. Holotype, In. 57475. ×2. Note facial suture, with rostral plate in position.

FIG. 8. Internal mould of incomplete cranidium, showing lobation of glabella, and left ocular ridge. Paratype, In. 56682. ×1·5.

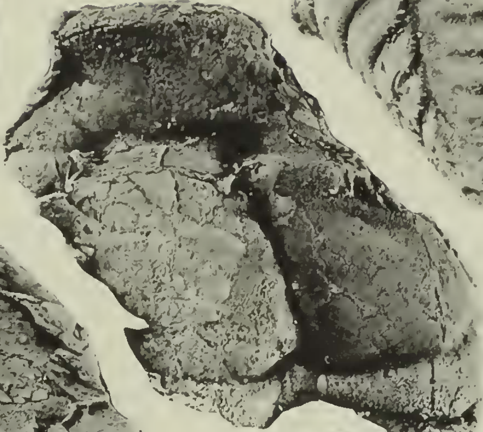
FIG. 9. Internal mould of cranidium. Paratype, In. 57474. ×1·4.

PLATE 13



1

2



3

4

5

6

7

8

9

PLATE 14

Neseuretus arenosus sp. nov. p. 313

Couches du Landeyran inférieures
from loose concretion found 400 metres north-east of l'Escougoussou.

FIGS. 1, 4, 8. Internal mould of pygidium. Paratype, In.57751. ×4.

Couches du Foulon, locality λ7, about 500 metres south-west of Upper Bridge, Landeyran Valley.

FIG. 5. Internal mould of pygidium. Paratype, In.57752. ×4.
FIGS. 7, 9, 11. Latex cast of cranidium. Holotype, In.57754. ×5.

Neseuretus attenuatus (Gigout) p. 317

Ordovician : Llanvirn? Series.
Jbel Zini, near Tilemsoun, Anti Atlas, Morocco.

FIGS. 2, 6, 12. Internal mould of topotype cranidium. Destombes Coll., It.244. ×3.

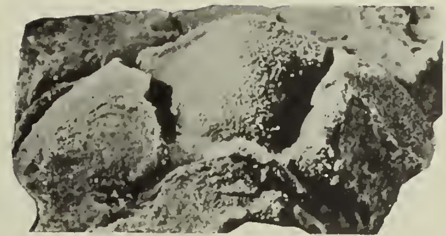
Platycoryphe convergens sp. nov. p. 318

Couches du Landeyran supérieures, locality λ19,
near southern end of Landeyran Valley.

FIGS. 3, 10, 13. Anterior, left lateral and plan views of internal mould of cranidium. Holotype, In.57756. ×7.


1


2


3


4


5

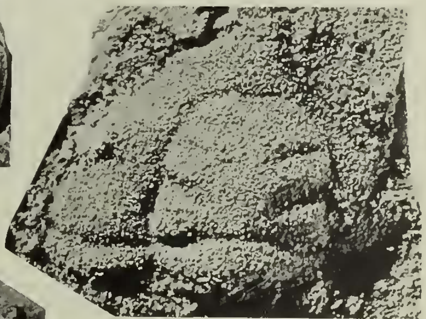

6


7


8


9


10


11


12

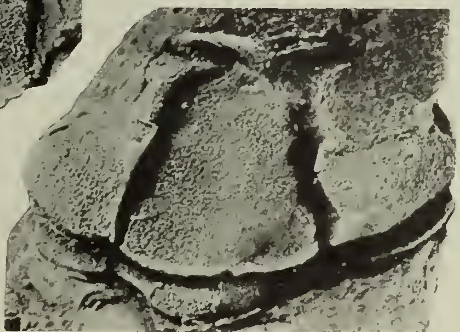

13

PLATE 15

Proetid gen. et sp. indet. p. 338

Horizon probably Couches du Landeyran inférieures ;
" Le Foulon ", exact locality unspecified.

FIGS. 1, 7. Plan and anterior views of internal mould of cranidium. University of Montpellier. ×3.

Niobella* cf. *lignieresi (Bergeron) p. 329

Couches du Landeyran inférieures,
locality $\lambda 4$, near northern end of Landeyran Valley.

FIG. 2. Latex cast of cranidium. It.252. ×1·5.

Horizon as for Fig. 2.
Locality $\lambda 5$, near northern end of Landeyran Valley.

FIG. 4. Internal mould of pygidium. In.57744. ×1·5.

Niobella? sp. p. 329

Horizon as for Fig. 2.
Locality $\lambda 2$, near northern end of Landeyran Valley.

FIG. 3. Latex cast of anterior portion of cranidium. It.253. ×1·5.

***Megistaspis* (*Ekeraspis*)?** sp. p. 324

Couches du Landeyran supérieures,
locality $\lambda 16$, near southern end of Landeyran Valley.

FIGS. 5, 6. Posterior and plan views of internal mould of pygidium. In.56666. ×2.

Horizon as for Fig. 5.
Locality $\lambda 19$, near southern end of Landeyran Valley.

FIG. 8. Internal mould of pygidium. It.259. ×2.

Niobella fourneti (Thoral) p. 328

Horizon and locality as for Fig. 1.

FIG. 9. Internal mould of cranidium. University of Montpellier. ×3.

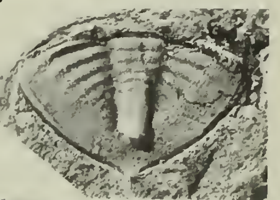
1

2

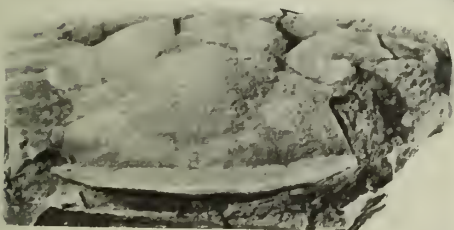
4

3

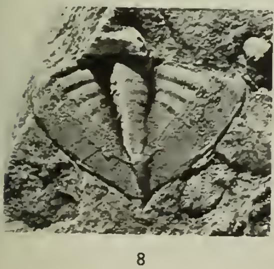
5



6



7



8

9

PLATE 16

Taihungshania landayranensis (Thoral) p. 331

Schistes de Setso, Ruisseau de Setso,
about 1500 metres west-south-west of Upper Bridge.

FIG. 1. External mould of typical cranidium. Matte Coll., University of Montpellier. ×2.
FIG. 7. Internal mould of pygidium. Collection as above. ×2.

Megistaspis (***Ekeraspis***) sp. p. 323

Couches du Landeyran inférieures,
locality λ30, hillside section south-west of Le Foulon.

FIG. 2. Internal mould of small cranidium. It.254. ×6.

Horizon as for Fig. 2.
Locality λ4, near northern end of Landeyran Valley.

FIG. 9. Internal mould of cranidium. In.57682. ×1·5.

Couches du Landeyran supérieures,
locality λ16, near southern end of Landeyran Valley.

FIG. 10. Internal mould of cranidium. In.57741. ×1·5.

Taihungshania miqueli (Bergeron) p. 331

Arenig Series, La Maurerie,
near Prades-sur-Vernazobres, east of St. Chinian.

FIGS. 3, 4. Plan and posterior views of internal mould of pygidium. It.427. ×3.

Basiliella mediterranea sp. nov. p. 320

Horizon as for Fig. 2.
Locality λ31, hillside section south-west of Le Foulon.

FIG. 5. Enlargement showing hypostoma in place. Paratype, It.257. ×4.

Taihungshania sp. p. 332

Horizon as for Fig. 10.
Locality λ19, near southern end of Landeyran Valley.

FIGS. 6, 8. Oblique left lateral and plan views of internal mould of cranidium. In.57750. ×1·5.

Megistaspis (s.l.) sp. p. 324

Couches du Landeyran, exact horizon uncertain.
Landeyran Valley, locality not specified.

FIG. 11. Internal mould of incomplete, large hypostoma. University of Montpellier. ×1.

Megalaspidella (***Megalaspidella***) sp. p. 324

Horizon as for Fig. 10.
Locality λ20, near southern end of Landeyran Valley.

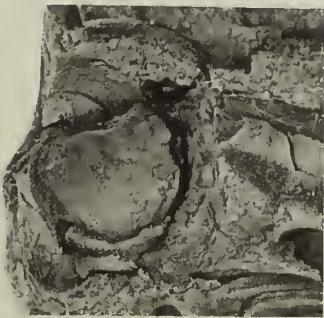
FIG. 12. Internal mould of small cephalon. In.57719. ×5.

1

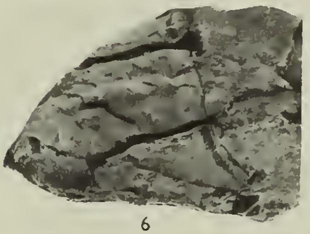
2

3

4



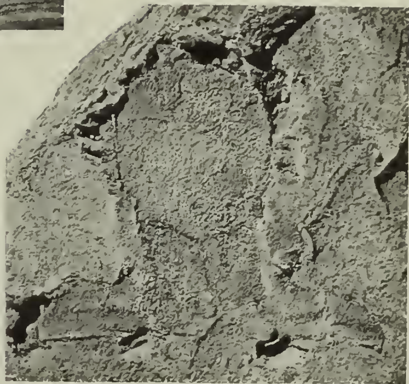
5



6

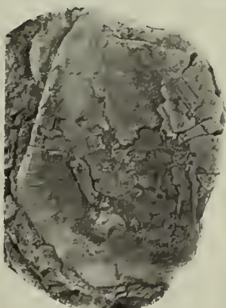
7

8

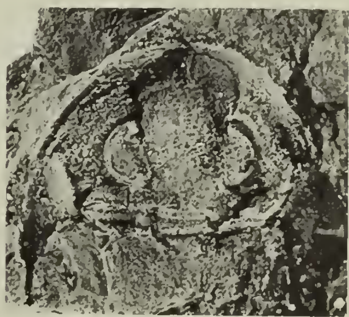


9

10



11



12

PLATE 17

Basiliella mediterranea sp. nov. p. 320

Couches du Landeyran supérieures,
locality λ21, near southern end of Landeyran Valley.

FIGS. 1, 4. Plan and anterior views of internal mould of cranidium. Holotype, It. 399. ×4.

Horizon as for Fig. 1.
Locality λ17, near southern end of Landeyran Valley.

FIG. 3. Internal mould of cranidium. Paratype, In. 56847. ×4.
FIGS. 11, 13. Posterior and plan views of internal mould of pygidium. Paratype. In. 56856. ×1·5.

Couches du Landeyran inférieures,
locality λ31, hillside section south-west of Le Foulon.

FIG. 8. Internal mould of incomplete dorsal exoskeleton. Paratype, It. 257. ×1·5.

Horizon as for Fig. 1.
Locality λ8, eastern side of Landeyran Valley.

FIG. 12. Latex cast of incomplete pygidium. Paratype, It. 260. ×3.

Basiliella sp. p. 322

Horizon and locality as for Fig. 3.

FIG. 2. Internal mould of incomplete hypostoma. In. 56844. ×1·8.
FIG. 6. Internal mould of hypostoma. In. 57742. ×3.

?Basiliella mediterranea sp. nov. p. 322

Horizon as for Fig. 8.
Locality λ32, hillside section south-west of Le Foulon.

FIG. 9. Latex cast of hypostoma. It. 269. ×2·5.

Paramegalaspis sp. p. 326

Horion as for Fig. 8.
Locality λ30, hillside section south-west of Le Foulon.

FIG. 5. Latex cast of Meraspis, Degree 3. It. 264. ×14.
FIG. 14. External mould of Meraspis, Degree 4. It. 265. ×14.
FIG. 15. Internal mould of Meraspis, Degree 6. It. 263. ×14.

Horizon as for Fig. 1.
Locality λ16, near southern end of Landeyran Valley.

FIG. 10. Latex cast of Meraspis, Degree 7. In. 57740. ×7.

Megalaspidella sp. (***Megalaspidella***) p. 324

Horizon as for Fig. 8.
Locality λ33, hillside section south-west of Le Foulon.

FIG. 7. Internal mould of hypostoma. It. 268. ×2·5.

Ogygiocaris sp. p. 330

Horizon and locality as for Fig. 9.

FIG. 16. Internal mould of fragmentary pygidium. It. 256. ×1·5.

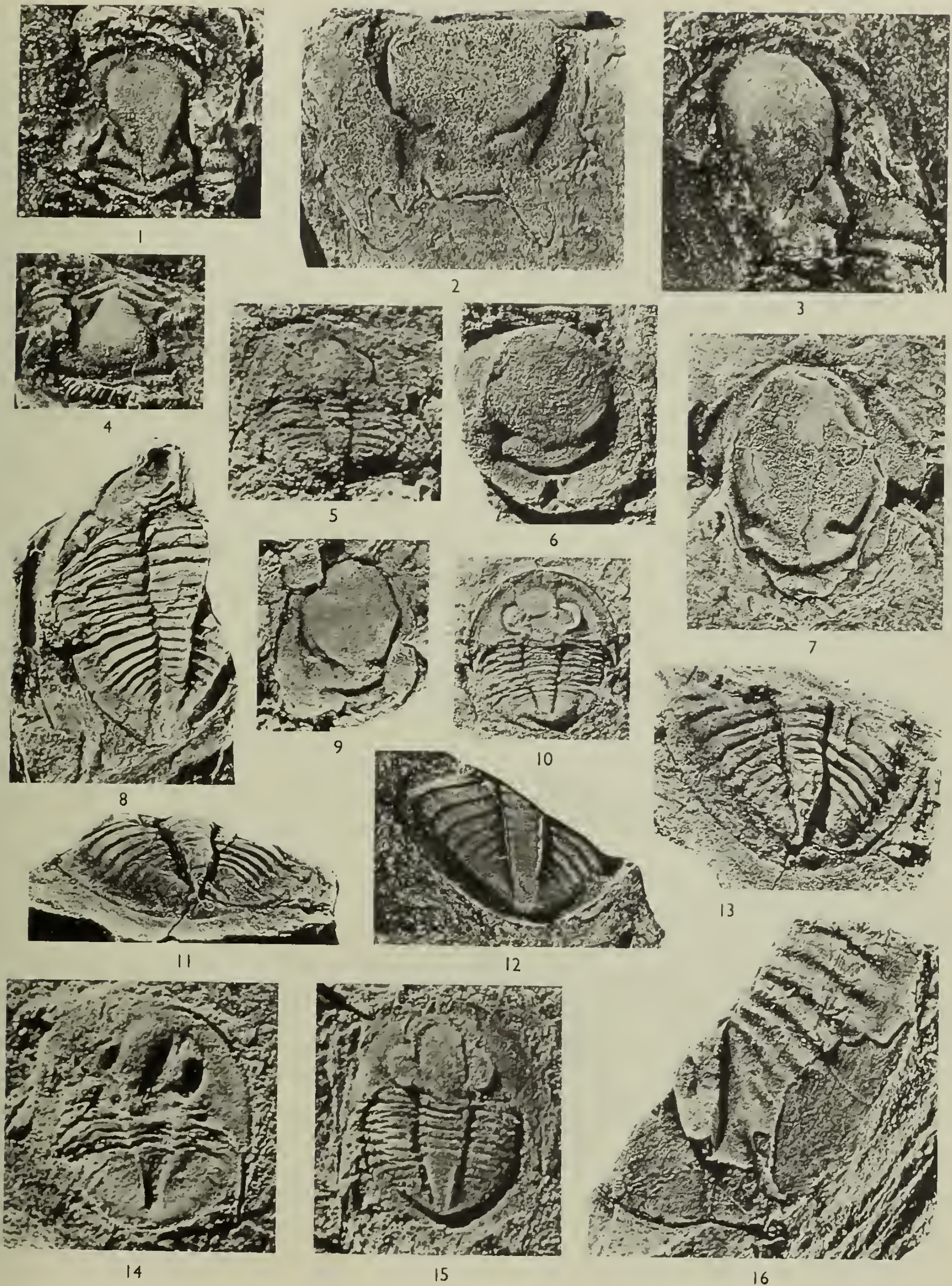

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

PLATE 18

Paramegalaspis* cf. *frequens Thoral p. 325

Couches du Landeyran, exact horizon uncertain,
found loose in vicinity of locality λ17, near southern end of Landeyran Valley.

FIGS. 1, 3, 8. Left lateral, anterior, and plan views of cranidium. Figs. 1, 3, internal moulds, Fig. 8, latex cast. It.271. ×1·5.

Probably Couches du Landeyran inférieures
near locality λ4, northern end of Landeyran Valley.

FIGS. 2, 10, 13. Posterior, left lateral, and plan views of pygidium, an internal mould. In.57681. ×1·5.

Symphysurus sabulosus sp. nov. p. 322

Couches du Foulon,
locality λ7, south-west of Upper Bridge, Landeyran Valley.

FIGS. 4, 5, 7. Right lateral, anterior, and plan views of internal mould of cranidium. Holotype. In.57729. ×7.

FIG. 6. Internal mould of cranidium. Paratype, In.57730. ×10.

Paramegalaspis sp. p. 326

Horizon and locality as for Fig. 4.

FIG. 9. Internal mould of hypostoma. In.57734. ×7.

Couches du Landeyran supérieures
locality λ20, near southern end of Landeyran Valley.

FIG. 11. Internal mould of pygidium. In.57749. ×2.

Horizon as for Fig. 2.
Locality λ2, near northern end of Landeyran Valley.

FIG. 12. Internal mould of pygidium. It.261. ×2.

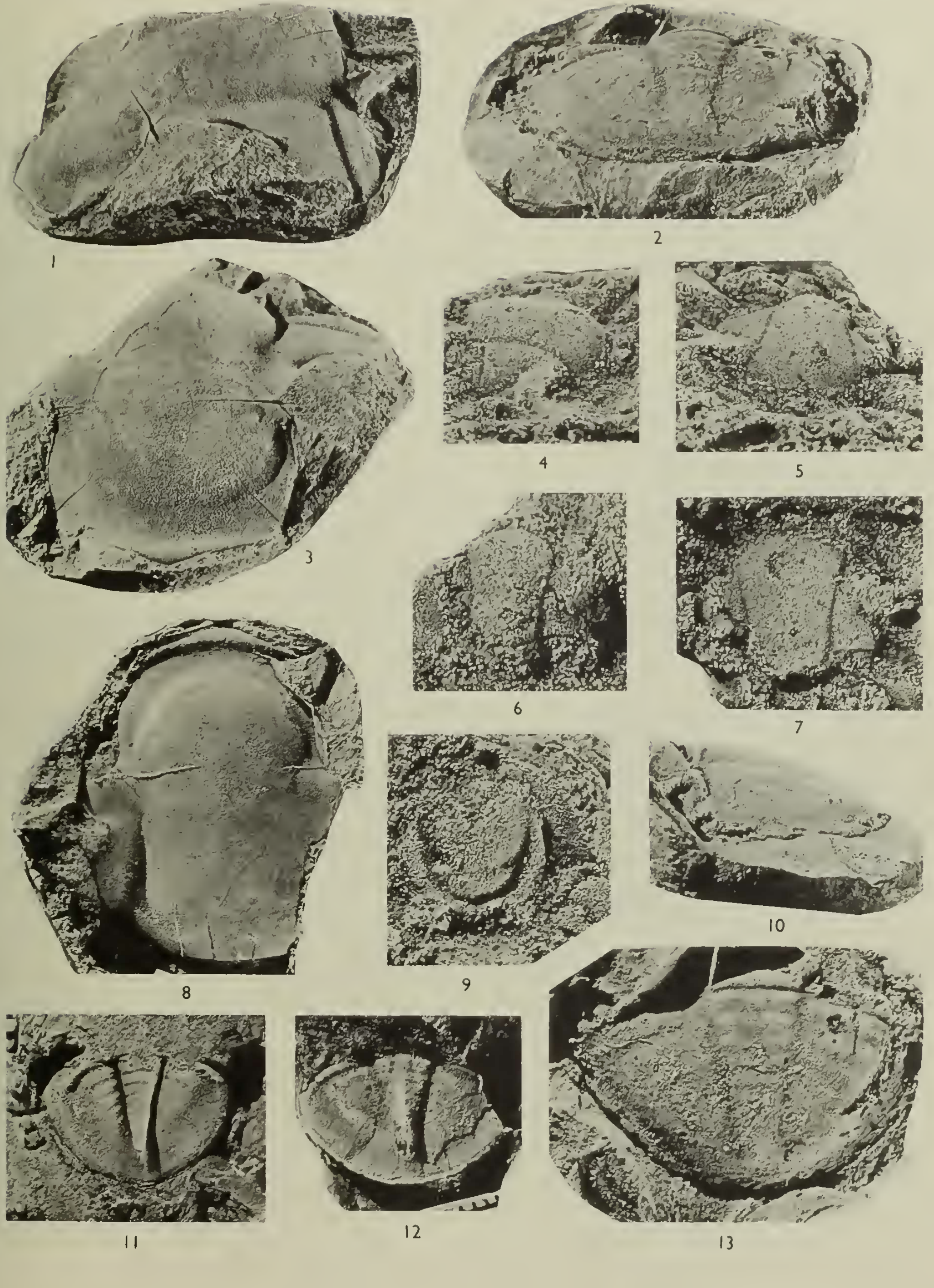

1
2
3
4
5
6
7
8
9
10
11
12
13

PLATE 19

Hoekaspis? quadrata sp. nov. p. 327

Couches du Landeyran inférieures,
locality λ6, near northern end of Landeyran Valley.

FIGS. 1, 7, 8. Latex cast of cranidium. Holotype. It.428. ×8.
FIGS. 3, 5, 9. Internal mould of same specimen. ×8.
FIGS. 2, 4, 6. Latex cast of small cranidium. Paratype, It.429. ×8.
FIG. 12. Internal mould of same specimen. ×8.
FIG. 10. Latex cast of fragmentary cranidium. Paratype, It.430. ×8.

Otarion insolitum sp. nov. p. 337

Couches du Landeyran supérieures,
locality λ19, near southern end of Landeyran Valley.

FIGS. 11, 13, 14. Anterior, left lateral and plan views of internal mould of cranidium. Holotype. In.57452. ×12.

PLATE 19

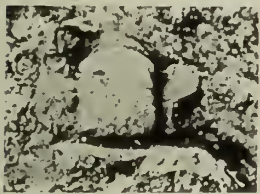

1


2


3


4

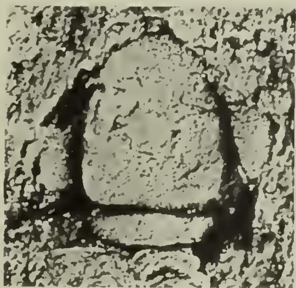

5

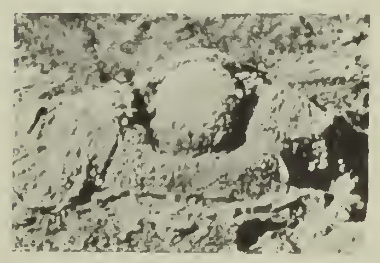

6


7

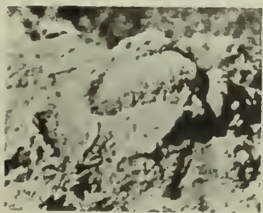

8


9


10


11


12


13


14

PLATE 20

Apatokephalus incisus sp. nov. p. 339

Couches du Landeyran inférieures,
locality $\lambda 33$, hillside section south-west of Le Foulon.

FIGS. 1, 2. Internal mould and latex cast of cranidium and part of thorax. Holotype, It.176. ×7.

FIG. 3. Latex cast of small cranidium. Paratype, It.177. ×9.

FIG. 6. Latex cast of thorax and pygidium with fragmentary cranidium and left librigena. Paratype, It.179, ×7.

FIG. 9. External mould of part of ventral side of pygidium. Paratype, It.183. ×3.

Horizon as for Fig. 1.
Locality $\lambda 30$, hillside section south-west of Le Foulon.

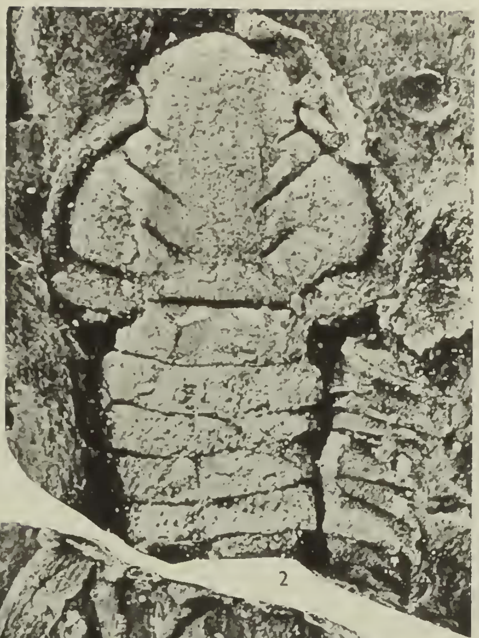
FIG. 5. External mould of left librigena, slightly displaced from cranidium. Paratype, It.287. ×7.

Selenopeltis binodosus sp. nov. p. 334

Horizon and locality as for Fig. 1.

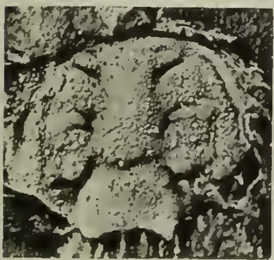
FIGS. 4, 7, 8. Plan, left anterolateral and anterior views of latex cast of cranidium. Holotype, It.180. ×5.

1



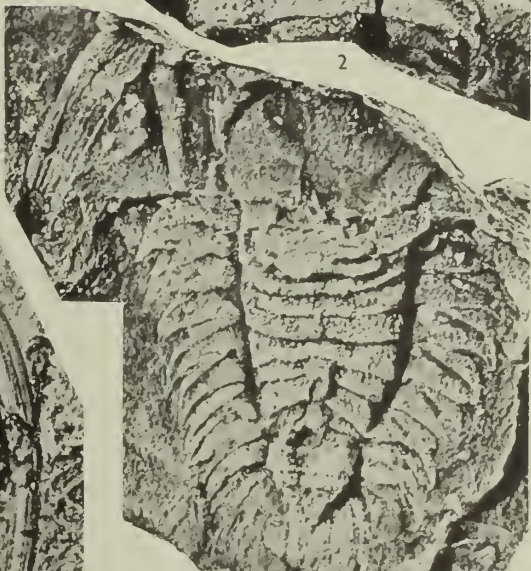
2

3



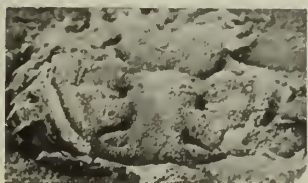
4

5



6

7



8

9

PLATE 21

Apatokephalus incisus sp. nov. p. 339

Couches du Landeyran inférieures,
locality λ31, hillside section south-west of Le Foulon.

Fig. 1. Latex cast of cephalon showing librigenae in position. Paratype, It. 181. ×8.

Horizon as for Fig. 1.
Locality λ33, hillside section south-west of Le Foulon.

Fig. 2. Internal mould of cranidium showing large lateral extension of anterior border. Paratype, It. 182. ×7.

Fig. 4. Latex cast of pygidium. Paratype, It. 183. ×8.

Horizon as for Fig. 1.
Locality λ2, near northern end of Landeyran Valley.

Figs. 3, 7. Latex cast and external mould of cranidium, showing granulated surface of test, and row of pits in front of the glabella. Paratype, In. 57422. ×11.

Apatokephalus? brevifrons Thoral p. 344

Arenig Series,
400 metres west of Prades-sur-Vernazobres, Hérault.

Fig. 5. Cast of holotype cranidium. University of Montpellier. ×7.

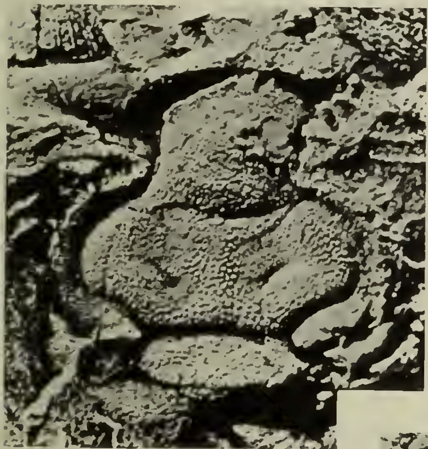
Selenopeltis sp. p. 336

Horizon and locality as for Fig. 2.

Fig. 6. Latex cast of fragmentary pleura showing long, backwardly-directed posterior pleural spine. It. 184. ×3.

1

2



3

4

5

6

7